Note to Reader: This is a revised working draft prepared by the BDCP consultants. This document is currently undergoing review by the Department of Water Resources with input from the Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Bureau of Reclamation and does not necessarily reflect the position of the state or federal agencies. It is expected to go through several more revisions prior to being released for formal public review and comment in 2012. All members of the public will have an opportunity to provide comments on the public draft of a revised version of this document during the formal public review and comment period. Responses will be prepared only on comments submitted in the formal public review and comment period.

APPENDIX 3.A
BACKGROUND ON THE PROCESS OF DEVELOPING THE BDCP CONSERVATION MEASURES

ADMINISTRATIVE DRAFT
BAY DELTA CONSERVATION PLAN

February 2012

ICF International. 2012. *Appendix 3.A Background on the Development of the BDCP Conservation Measures.* Administrative Draft. *Bay Delta Conservation Plan*. February. (ICF 00610.10).

APPENDIX D. BACKGROUND ON THE PROCESS OF DEVELOPING THE BDCP CONSERVATION MEASURES

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APPENDIX D. BACKGROUND ON THE PROCESS OF DEVELOPING THE BDCP CONSERVATION MEASURES

[***Note to reviewers:*** *The purpose of this document is to memorialize the process that was used by the BDCP Steering Committee in its consideration of different approaches to the development of conservation measures for the BDCP Conservation Strategy and to provide a context for decisions to reject alternatives to the Conservation Strategy proposed by the BDCP. It identifies the key conservation measure options considered by the Steering Committee and the reasons why those options were not included in the proposed conservation measures. The document focuses on the period of Steering Committee deliberations spanning from February 2007 to Nov. 2010. This appendix will be revised for the public draft to update information to its current status.*]

D.1 INTRODUCTION

This document describes the process used and options considered in the development of various elements of the BDCP conservation strategy. It provides a history of the BDCP development process starting with the Planning Agreement in October 2006 through the development of the draft conservation strategy. Additionally, it serves to describe the basis, background, and context for the alternatives to take that are identified and discussed in Chapter 9 *Alternatives to Take*. The ESA requires that section 10(a)(1)(B) permit applicants specify in an HCP what alternative actions to the taking of federally listed species were considered and the reasons why those alternatives are not proposed to be used [50 CFR §17.22(b)(1)(iii)(C)]. Chapter 9 describes the decision process by which the BDCP Steering Committee[1] selected conservation measures to avoid and minimize take, and appropriately mitigate any unavoidable take that would likely occur as a result of the activities proposed for coverage under the BDCP. The chapter further details limits and constraints, including issues concerning practicability that guided the development of the Conservation Strategy.

As described in Chapter 1, the BDCP is intended to address the conflict between the ecological needs of a number of at-risk species adversely affected by a range of human activities and the need for adequate and reliable water supplies from the Sacramento-San Joaquin River Delta (Delta), and the streams tributaries thereto, for people, communities, agriculture, and industry. The BDCP sets out conservation strategies for the Delta that reflect the co-equal planning goals of restoring the ecological functions of the Delta and improving water supply reliability to large portions of the State of California. The development of the conservation strategy was informed

[1] Development of the BDCP has been guided by the Steering Committee, The proceedings of the Steering Committee, including convening of meetings, meeting agendas, and its deliberations, were facilitated by the California Natural Resources Agency. Steering Committee responsibilities included providing policy guidance and direction for the preparation of all elements of the BDCP. The Steering Committee formed various standing and ad hoc groups as needed to address specific technical issues related to BDCP development. The relevant technical groups and their scope of responsibility are described in this appendix. Working Groups were co-chaired by two Steering Committee members and technical committees were co-chaired by designated representatives of two Steering Committee members. Meetings of the Steering Committee and Steering Committee groups were noticed on the BDCP website and open to the public.

by findings and conceptual models developed over time through prior scientific efforts and supplemented by data and analysis developed through the BDCP process.

As further discussed in Chapter 1, the strategy was built upon the following scientific tenets and reflects the current state of available science:

- Increase the quality, availability, spatial diversity, and complexity of aquatic habitat within the Delta;
- Create new opportunities to restore the ecological health of the Delta by modifying the water infrastructure to convey water around the Delta, reducing reliance on conveyance of water through manmade and natural channels in the Delta to export pumping plants in the southern Delta;
- Directly address key ecosystem drivers unrelated to freshwater flow patterns rather than manipulation of Delta flow patterns alone;
- Improve connectivity among aquatic habitats, facilitate migration and movement of covered fish among habitats, and provide transport flows for the dispersal of planktonic material (organic carbon), phytoplankton, zooplankton, macroinvertebrates, and fish eggs and larvae;
- Improve synchrony between environmental cues and conditions and the life history of covered fish and their food resources within the upstream rivers, Delta, and Suisun Bay, including the hydrologic seasonal synchrony within the watershed, seasonal water temperature gradients, salinity gradients, turbidity, and other environmental cues;
- Reduce sources of direct mortality and other stressors on the covered fish and the aquatic ecosystem within the Delta;
- Improve habitat conditions for covered fish in upstream river reaches, within the Delta, and downstream within the low salinity zone of the estuary in Suisun Bay through the integration of water operations with physical habitat enhancement and restoration; and
- Rely, to the extent possible, on natural physical habitat and biological processes to support and maintain covered fish species and their habitat.

This document describes the conservation actions evaluated and the evaluation process conducted to develop a conservation strategy based on the scientific tenets, above. The BDCP Steering Committee used various sources of information to help inform its consideration of different options for the development of a conservation strategy. Among those documents was a report issued by the Public Policy Institute of California (PPIC), *Envisioning Futures for the Sacramento-San Joaquin Delta* (PPIC 2007). The Steering Committee also reviewed CALFED Program documents to further guide the consideration of potential conservation strategies. The BDCP Conservation Strategy Workgroup (established by the Steering Committee in February 2007) evaluated various approaches to conservation from these sources and others and developed a list of ten conservation strategy alternatives (CSAs). The subsequent Conservation Strategy

Short-Listing Analysis Report (SAIC 2007a) identified "bundles" of potential conservation elements that were evaluated to determine the relative capacity of each of the bundles to achieve BDCP goals and objectives. A short list of four Conveyance Options was then developed by the Steering Committee based on the results of the Short-Listing Analysis. The BDCP Options Evaluation Report (SAIC 2007b) assessed the four Conveyance Options and its results helped provide the basis for the BDCP "Points of Agreement for Continuing into the Planning Process," (Steering Committee 2007) which concluded that a dual conveyance was the most promising approach to evaluate in the planning process. The Steering Committee and its various focused working groups and technical teams developed and evaluated various conservation approaches and actions under dual conveyance, including variations related to water operations conservation measures, physical habitat restoration measures, other stressors conservation measures, and terrestrial habitat conservation measures. In January 2009, the Steering Committee identified the "core elements" to be carried forward in the conservation strategy (*An Overview of the Draft Conservation Strategy for the Bay Delta Conservation Plan*, January 12, 2009) and in July 2009 a working draft of BDCP Chapter 3 *Conservation Strategy* was prepared and posted on the BDCP Website. In January to March 2010, the Steering Committee indentified the specific conservation measures that would be included in the working draft conservation strategy to be evaluated in the BDCP Effects Analysis conducted during spring and summer 2010. This document provides a detailed description of the process used to develop a conservation strategy for the BDCP.

D.2 Evaluation of Conservation Strategy Options and Scenarios

D.2.1 Conservation Strategy Options

In the February 2007, the Steering Committee established a Conservation Strategy Workgroup to begin evaluating options for the BDCP conservation strategy. At this stage in plan development the focus was on the conservation of aquatic habitats that support delta smelt, longfin smelt, winter-run Chinook, spring-run Chinook, fall-run Chinook, Central Valley steelhead, green sturgeon, white sturgeon, and Sacramento splittail. Other fish species, wildlife, and plants had not yet been evaluated and included in the covered species list.

The Workgroup began by reviewing existing studies of proposed habitat conservation and water conveyance approaches for the Delta. A variety of sources were considered including the aforementioned report published by the PPIC describing various alternative approaches to restoring the Delta ecosystem while continuing to export water (PPIC 2007). By way of example of the sources considered, a summary of the PPIC nine alternatives, evaluations conclusions, and associated rationale set forth in the report are provided in Table D-1 (more detail may be found in the report). The Conservation Strategy Workgroup considered the alternatives recommended by the PPIC report (identified as "consider" in Table D-1) in the development of draft conservation strategy alternatives (CSAs) for the BDCP. Other sources were also considered and

independent judgments were formed about the benefits and drawbacks of the various alternatives.

The CALFED Bay-Delta Program evaluated a number of conveyance and conservation alternatives and subalternatives including existing conveyance, modified through-Delta conveyance, and dual conveyance with an isolated facility. The Workgroup used this CALFED information in the development of alternatives.

Based upon the five approaches suggested by the PPIC report, other approaches evaluated by the CALFED Program, and an additional alternative recommended by local interests, the Conservation Strategy Workgroup identified ten CSAs (BDCP Conservation Strategy Workgroup Working Draft, Revised Handout #1, Draft CSAs, April 23, 2007) for consideration in developing a BDCP conservation strategy (Table D-2 and Figures D-1 through D-10).

Table D-1. Summary Description of Alternatives Developed and Evaluated in the PPIC Report (PPIC 2007)

PPIC Alternative	*Details*	*PPIC Summary Evaluation*	*Rationale*
Freshwater Delta Alternatives aim to maintain the Delta as homogenous freshwater body. Delta salinity could be controlled through levees, outflows, and barrier structures.			
Alternative 1. Levees as usual – current or increased effort	The current levee-intensive system would be maintained at recent levels of effort or modestly upgraded to meet federal standards for agricultural levees. Water exports would continue to be pumped through the Delta. Levee failures would occur with increasing frequency.	Eliminate	Current and foreseeable investments at best continue a risky situation; other soft landing approaches are more promising; not sustainable in any sense
Alternative 2. Fortress Delta (Dutch standards)	"Whatever it takes" investments would be made to support or fix levees deemed strategically important for urban areas, infrastructure, and water supply exports. To contain costs, the total length of the levees in the system would be shortened, reconfiguring some islands. Lower-reliability levees (mainly in the interior of the Delta) would be allowed to fail.	Eliminate	Great expense; unable to resolve important ecosystem issues
Alternative 3. Seaward saltwater barrier	A permanent or movable barrier would be erected at the western edge of the Delta. This is one of the oldest and most extreme proposals for keeping salt water at bay, but it has recently reemerged because Dutch engineers have suggested the construction of a large movable barrier, similar to the Maeslant storm surge barrier that protects Rotterdam in The Netherlands.	Eliminate	Great expense; profoundly undesirable ecosystem performance; water quality risks
Fluctuating Delta Alternatives aim for fluctuating environmental conditions in the western Delta (especially salinity) to improve habitat conditions for native fish species. Urbanization would be possible along the Delta's periphery behind strong levees.			
Alternative 4. Peripheral canal plus	An aqueduct would be constructed from the vicinity of Hood, on the Sacramento River, south along the Delta's eastern edge, sending water exports to Clifton Court Forebay. This would allow water exports to circumvent the Delta and yet continue to meet the Central Valley Project and State Water Project intakes. This proposal augments the traditional peripheral canal proposals with special operations, investments, and activities for environmental and other in-Delta land and water uses (hence the "plus").	Consider	Environmental performance uncertain, but promising; good water export reliability; large capital investment
Alternative 5. South Delta restoration aqueduct	This aqueduct would be similar to the peripheral canal mentioned above, but its major outlet would enter the lower San Joaquin River. These supplemental freshwater flows would resolve various water quality and flow problems of the lower San Joaquin River and the southern Delta while improving the quality of water exports and reducing entrainment of native fish at the pumps. Some flows could be channeled into a wetland and flood bypass channel through the southern Delta, contributing to improved habitat and agricultural water quality. In-Delta investments would be made for environmental and other in-Delta uses.	Consider	Environmental performance uncertain, but more adaptable than Alternative #4 Peripheral canal plus; water delivery promising for exports and in-Delta uses; large capital investment

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Table D-1. Summary Description of Alternatives Developed and Evaluated in the PPIC Report (PPIC 2007) (continued)

PPIC Alternative	*Details*	*PPIC Summary Evaluation*	*Rationale*
Alternative 6. Armored-island aqueduct	A major, semi-isolated freshwater conveyance corridor for water exports would be created by armoring select islands and cutting off or tide-gating various channels within the central-eastern Delta.	Consider	Environmental performance likely poor unless carefully designed; water delivery promising; large capital investment
Reduced-exports Delta Alternatives do not rely on new Delta export facilities or levees. However, they do imply an ability to greatly modify the pattern and quantity of Delta exports.			
Alternative 7. Opportunistic Delta	Only opportunistic seasonal exports would be allowed, during times of high discharge of freshwater from the Delta (generally winter and spring). Export pumping capacities would be expanded to accommodate these high pumping periods, and some surface storage within and near the Delta may be built. Salinity levels would fluctuate in the western Delta, and many islands would eventually become flooded. Urbanization would be possible along the Delta's periphery, behind strong levees.	Consider	Expenses and risks shift to importing areas; relatively low capital investment; environmental effectiveness unclear
Alternative 8. Eco-Delta	The Delta would be managed as a single, unified entity to favor key Delta aquatic and terrestrial species. Water extraction, transportation corridors, and other functions would be maintained as long as they do not interfere with rehabilitation goals. Some water exports would occur but less than in the Opportunistic Delta alternative.	Consider	Initial costs likely to be very high; long-term benefits potentially high if Delta becomes park/open space/endangered species refuge
Alternative 9. Abandoned Delta	A planned, multi-decade retreat from the Delta would occur, with the phasing out of much of the Delta's farm economy. Water exporting agencies would transition to alternative water sources and would increase water use efficiency.	Eliminate	Poor overall economic performance; southern Delta water quality problems; like Alternative #1, without benefits

Table D-2. Conservation Strategy Alternatives Developed by the BDCP Conservation Strategy Workgroup

Conservation Strategy Alternative	*Title*	*Theme*
CSA-1	**Operations Modifications with Existing Conveyance Configuration**	Utilize existing Delta conveyance configuration; and improve SWP and CVP operations and facilities management and diversion-related infrastructure to reduce mortality of and improve flow-related habitat conditions for covered fish species sufficiently to increase their production, abundance, and distribution.
CSA-2	**In-Delta Habitat Restoration under Existing Operations**	Utilize existing Delta conveyance configuration and operations; and physically restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution.
CSA-3	**Opportunistic Exports with In-Delta (within BDCP Planning Area) Habitat Restoration**	Increase export capacity and limit exports to occur only during periods of high flow and when covered fish species are least vulnerable to entrainment; improve flow-related habitat conditions; and restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient habitat area and quality to increase covered species production, abundance, and distribution.
CSA-4	**South Delta Aqueduct (SDA) with In-Delta Habitat Restoration**	Create a new Delta conveyance configuration that would provide for improved fluctuating salinities and variable hydrology in the western and northern Delta and improve ecosystem water quality in the South Delta; and restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution.
CSA-5	**Isolated Facility (IF) with In-Delta Habitat Restoration**	Create a new Delta conveyance configuration that would provide fluctuating salinities and variable hydrology throughout the Delta and avoid entrainment at the pumps; and restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient habitat area and quality of covered species to increase their production, abundance, and distribution.
CSA-6	**Suisun Marsh Habitat Restoration in Combination with In-Delta Habitat Restoration**	Utilize the existing Delta conveyance configuration and operations; and restore physical aquatic and floodplain habitats within the Delta and Suisun Marsh to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution. This alternative would restore less in-Delta habitat (e.g., 40-60%) than would be restored under CSA 2.

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Table D-2. Conservation Strategy Alternatives Developed by the BDCP Conservation Strategy Workgroup (continued)

Conservation Strategy Alternative	*Title*	*Theme*
CSA-7	**Upstream Habitat Restoration in Combination with In-Delta (within planning area) Habitat Restoration**	Utilize the existing Delta conveyance configuration and operations; and restore physical aquatic and floodplain habitats within the Delta and outside the BDCP Planning Area along the Sacramento and San Joaquin rivers and their tributaries to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution. This alternative would restore less in-Delta habitat (e.g., 40-60%) than would be restored under CSA 2.
CSA-8	**Bifurcated SDA with In-Delta Habitat Restoration**	Alter the existing Delta conveyance configuration to provide for fluctuating salinities and variable hydrology in the western and northern Delta and improve ecosystem water quality in the South Delta; and restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient habitat area and quality of covered species to increase their production, abundance, and distribution.
CSA-9	**Dual Conveyance with In-Delta (within planning area) Habitat Restoration**	Alter the existing Delta conveyance configuration to provide flexibility in Delta operations to reduce effects of operations-related entrainment; improve fluctuating hydrologic conditions for covered fish species while maintaining in-Delta channel stage and water quality; and restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution.
CSA-10	**Split Delta with San Joaquin River Corridor Restoration**	Operate and reconfigure in-Delta conveyance of San Joaquin River to isolate covered fish species from the South Delta pumps; and restore estuarine habitat in the south and west Delta to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution.

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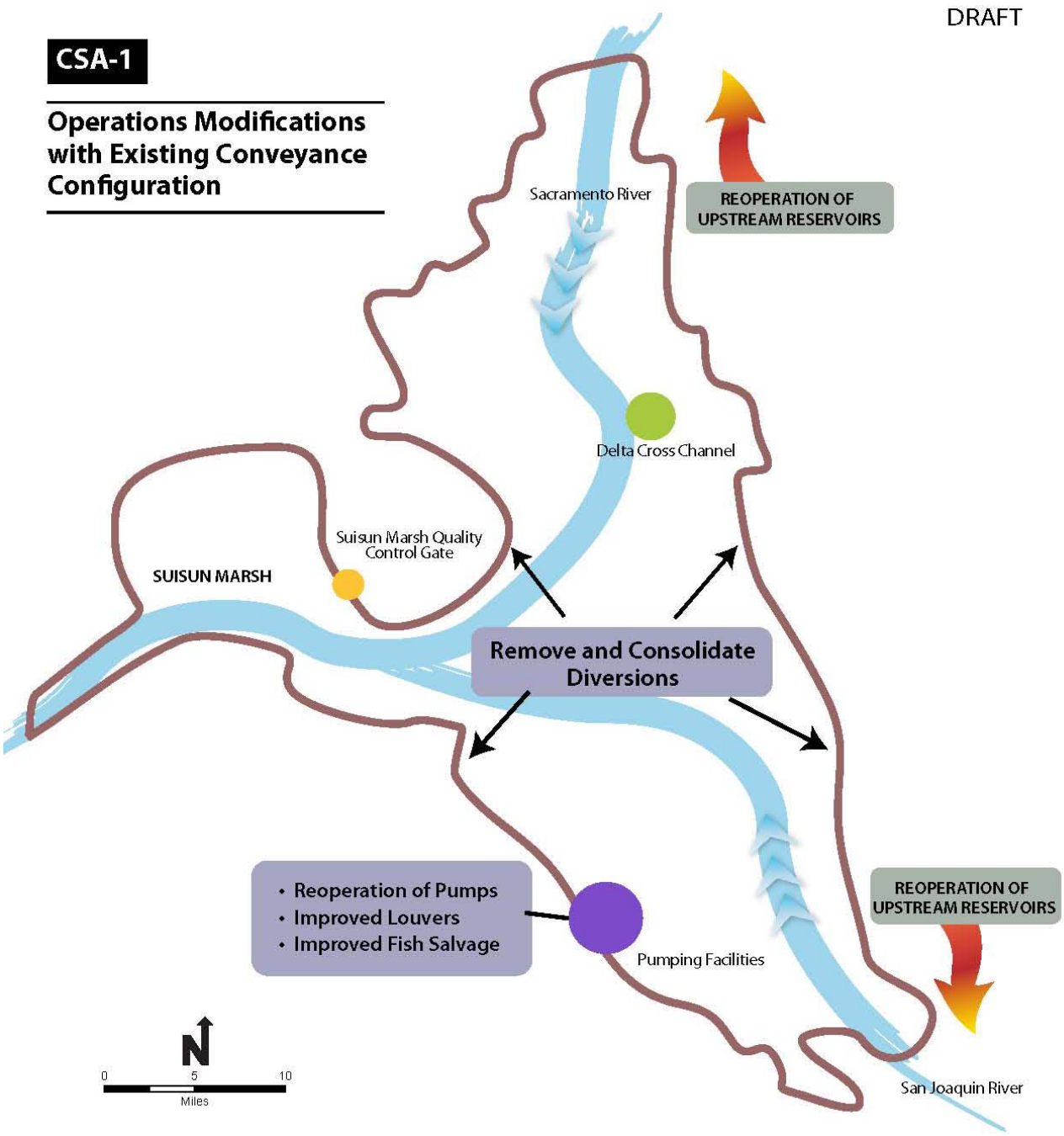


Figure D-1. CSA-1 Operations Modifications with Existing Conveyance Configuration

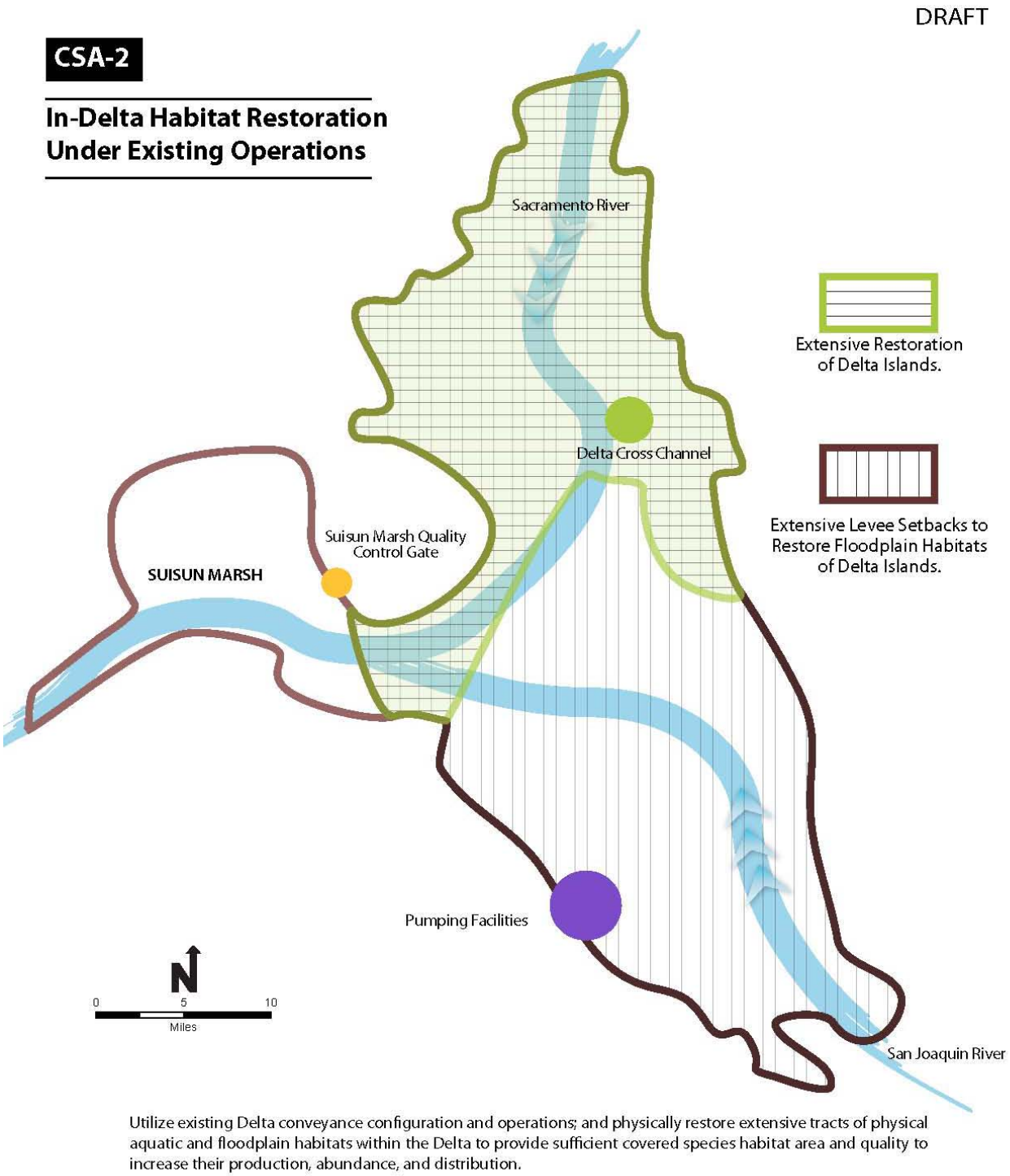


Figure D-2. CSA-2 In-Delta Habitat Restoration under Existing Operations

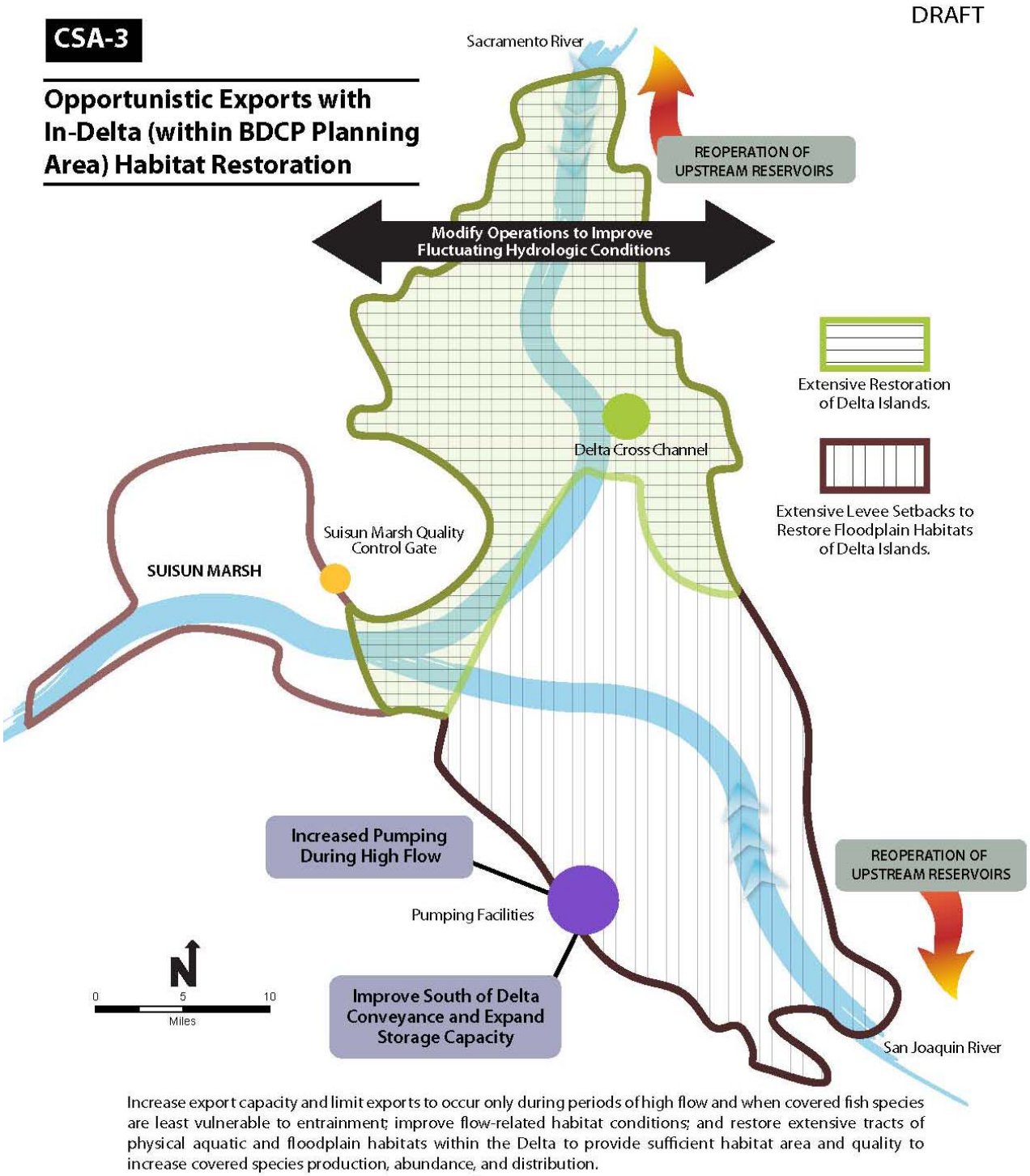


Figure D-3. CSA-3 Opportunistic Exports with In-Delta (within BDCP Planning Area) Habitat Restoration

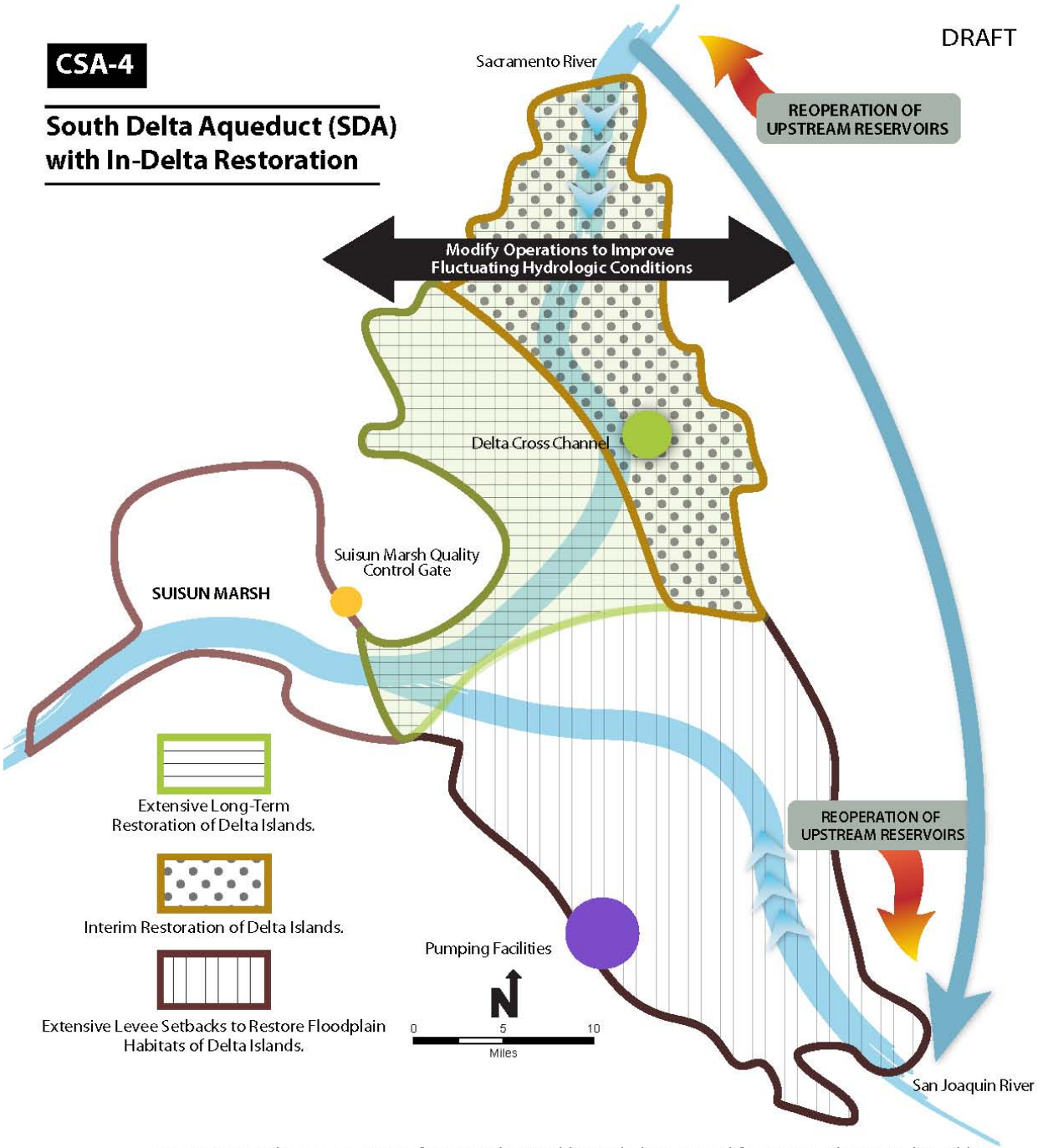


Figure D-4. CSA-4 South Delta Aqueduct (SDA) with In-Delta Habitat Restoration

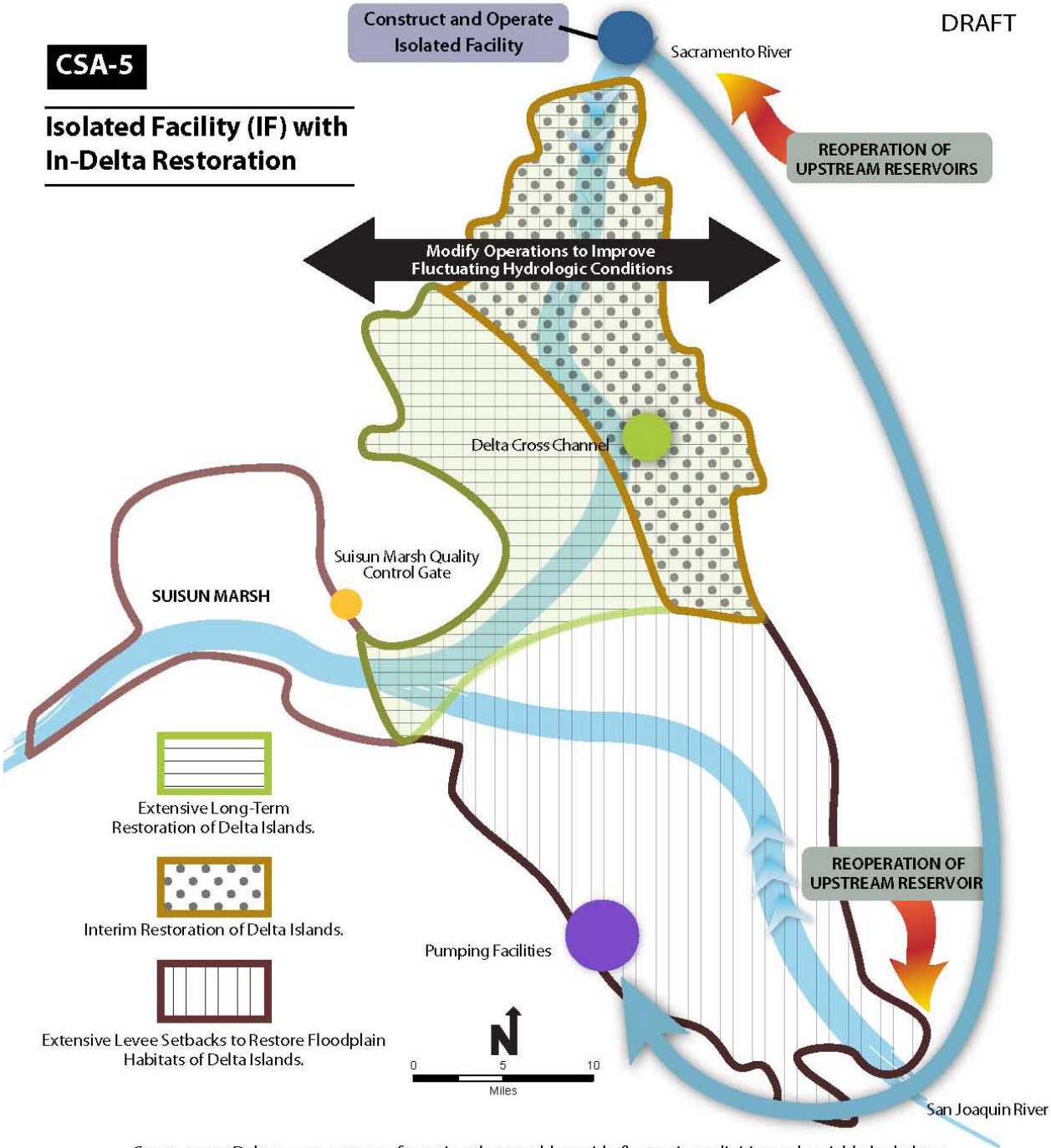
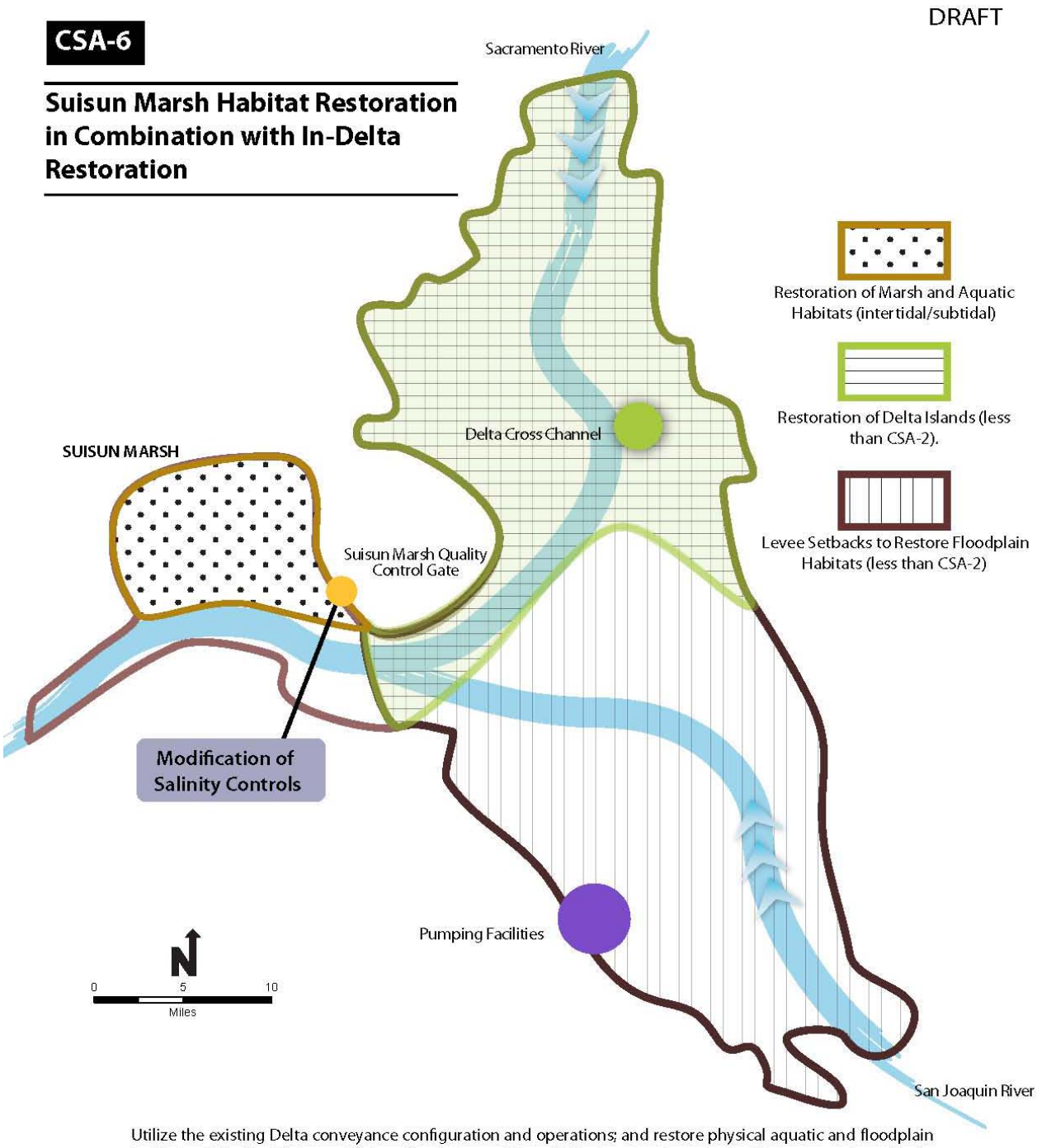


Figure D-5. CSA-5 Isolated Facility (IF) with In-Delta Habitat Restoration



Utilize the existing Delta conveyance configuration and operations; and restore physical aquatic and floodplain habitats within the Delta and Suisun Marsh to provide sufficient covered species habitat area and quality to increase their production, abundance, and distribution. This alternative would restore less in-Delta habitat (e.g., 40-60% less) than would be restored under CSA 2.

Figure D-6. CSA-6 Suisun Marsh Habitat Restoration in Combination with In-Delta Habitat Restoration

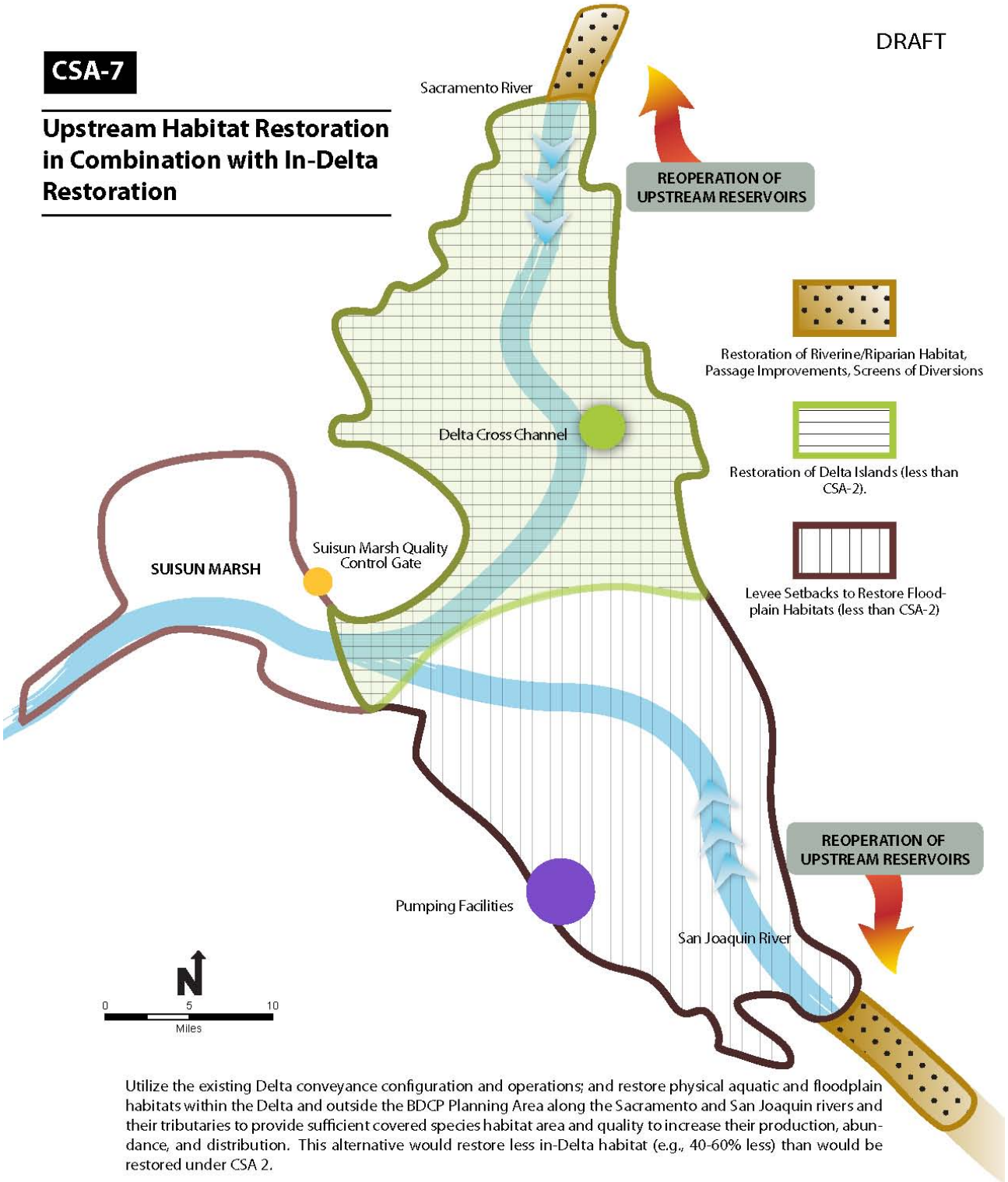
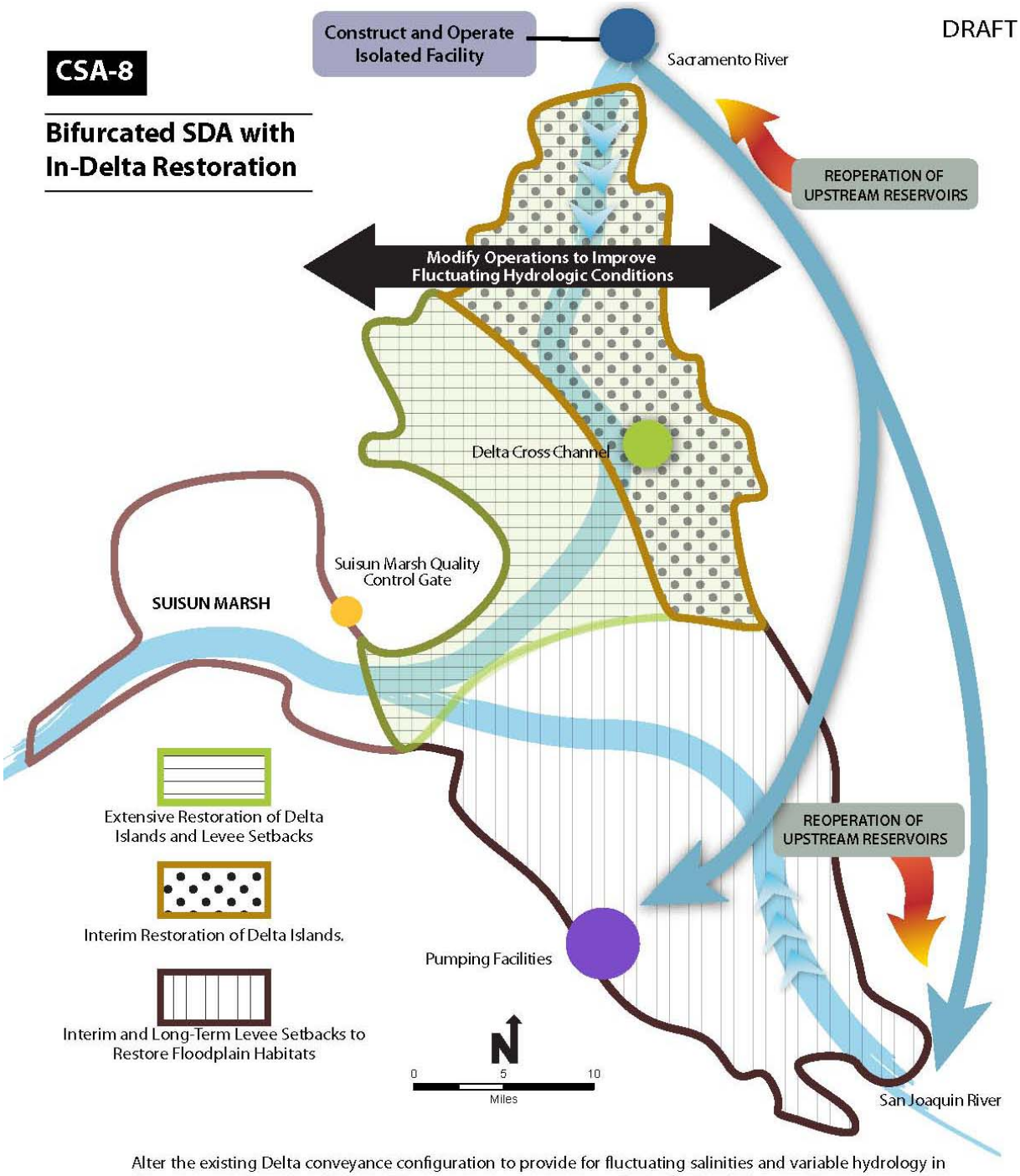


Figure D-7. CSA-7 Upstream Habitat Restoration in Combination with In-Delta (within planning area) Habitat Restoration



Alter the existing Delta conveyance configuration to provide for fluctuating salinities and variable hydrology in the western and northern Delta and improve ecosystem water quality in the South Delta; and restore extensive tracts of physical aquatic and floodplain habitats within the Delta to provide sufficient habitat area and quality of covered species to increase their production, abundance, and distribution.

Figure D-8. CSA-8 Bifurcated SDA with In-Delta Habitat Restoration

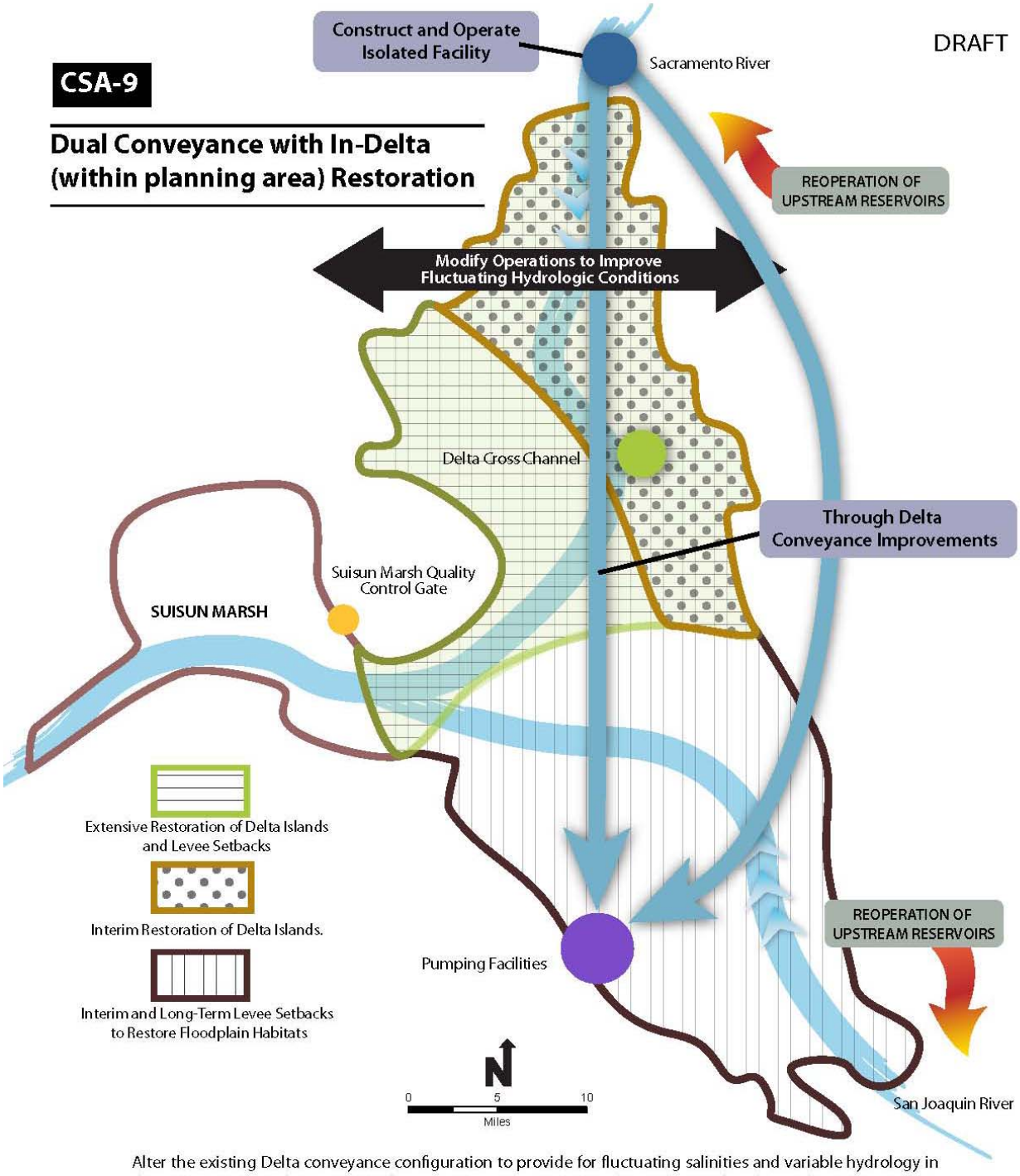


Figure D-9. CSA-9 Dual Conveyance with In-Delta (within planning area) Habitat Restoration

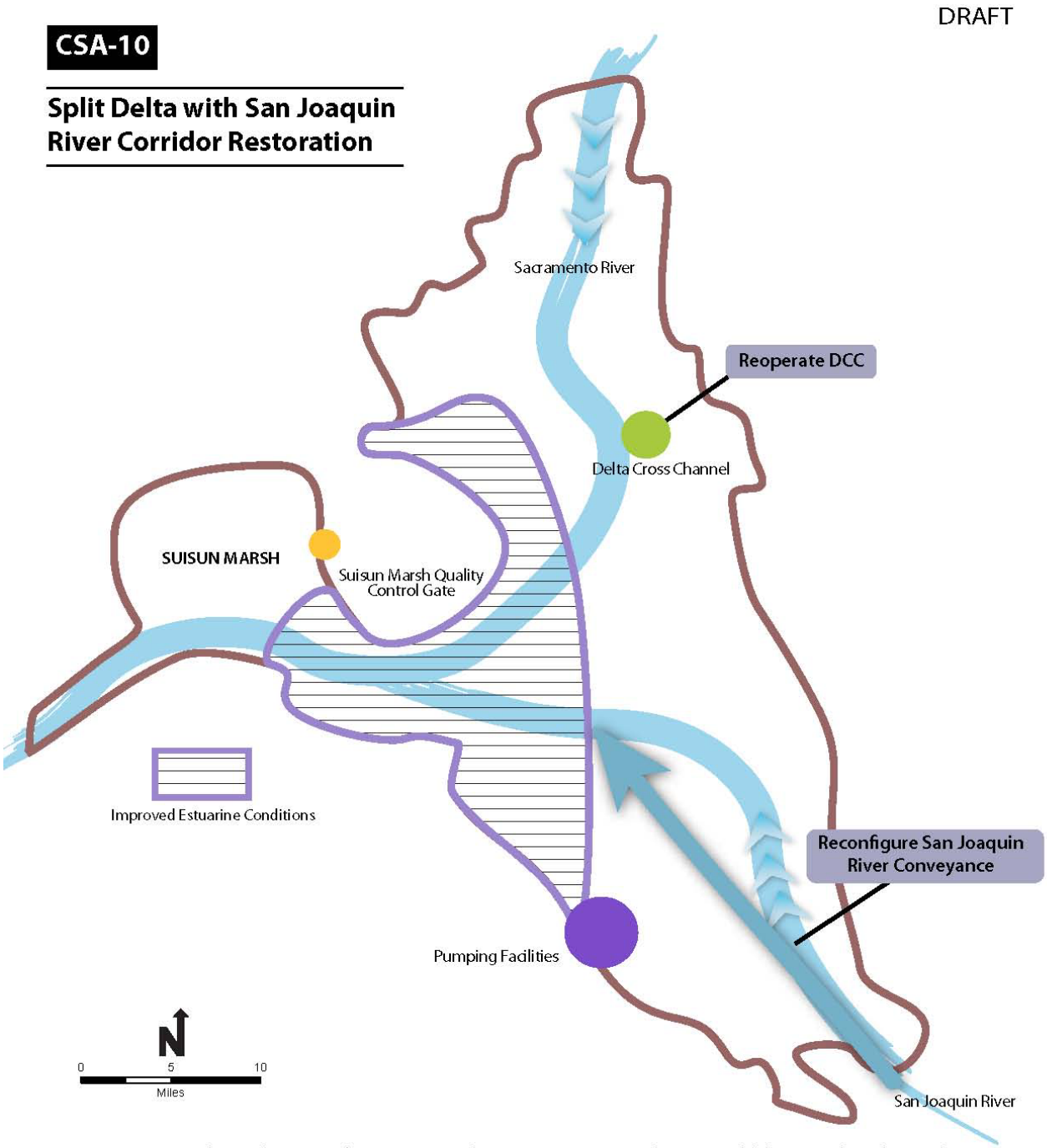


Figure D-10. CSA-10 Split Delta with San Joaquin River Corridor Restoration

D.2.2 Conservation Strategy Short-Listing Analysis

The ten CSAs identified by the Conservation Strategy Workgroup included over 50 distinct conservation elements (Table D-3). A "conservation element" was defined as an action or set of interrelated actions with a specific purpose, typically addressing one or a few ecological stressors on covered fish species. Each conservation element may address the conservation of covered species directly such as through mortality reduction or production increase or indirectly such as through habitat enhancement or restoration. Sets of different conservation elements addressing the full range of key stressors on fish make up a "conservation strategy." A conservation strategy is a full program of conservation elements that in total would serve to address all of the goals and objectives of the BDCP.

This large number of elements that could be included in a conservation strategy for the BDCP prompted the creation of "bundles" of elements. Each bundle encompassed elements that were related in their physical implementation and overall conservation purpose that would be logically implemented together. Twenty-two bundles (Table D-4) were created and analyzed in the Draft Conservation Strategy Short-Listing Analysis Report (SAIC 2007a). This report was completed by the BDCP consultant team in May of 2007 and provided to the Steering Committee. The report provides an overview of the anticipated benefits and drawbacks of conservation elements and provided information for the Conservation Strategy Workgroup to use in eliminating and re-aggregating the bundles into a short list of conservation strategy options (CSOs) for the BDCP.

The 22 bundles were grouped into four categories based on the type of actions they include:

- *Water Operations and Conveyance bundles* are water conveyance and export management elements, including some large scale Delta infrastructure construction options (e.g., peripheral aqueduct construction).
- *Entrainment and Predation Mortality Reduction Bundles* include physical modification of pumps and intakes to avoid impacts on covered species, and physical habitat improvements that would help fish avoid predation.
- *Flow-related Habitat Improvement Bundles* include re-operation, modification, or expansion of existing infrastructure in and upstream of the Delta to improve hydrologic and habitat conditions for covered species of fish, and also physical modification of habitat to improve water flow conditions for covered species of fish.
- *Physical Habitat Restoration Bundles* include physical improvements to enhance and restore habitat in historical habitat areas in the Delta and in downstream and upstream areas.

Table D-3. Elements of Draft Conservation Strategy Alternatives[2]

Conservation Strategy Alternative Elements	*Conservation Strategy Alternatives (CSAs)*[A]										
	Static Delta				**Fluctuating Delta**						
	Existing Conveyance Facilities				**New Conveyance Facilities**						
	1	**2**	**6**	**7**	**3**	**4**	**5**	**7**	**8**	**9**	**10**
Post-operational elements[3]											
• Real-time operation of CVP and SWP pumps to minimize entrainment of fish during sensitive time periods	X										
• Improvements to louver facilities at SWP and CVP pumps to minimize fish mortality	X										
• Improve the SWP/CVP salvage collection, handling, transportation, and release (CHTR) processes to increase survival	X										X
• Modify in-channel habitat structure at SWP/CVP facilities to reduce conditions that support predation of native fishes	X										
• Improve facilities and pumping operations to minimize passage of fish into Clifton Court Forebay (CCF)	X										
• Removal and consolidation of in-Delta diversions to minimize entrainment losses of fish	X					X	X				
• Improve the effectiveness of ineffective screened diversions within the Delta	X										
• Screen un-screened in-Delta diversions	X										
• Operate the Delta Cross Channel (DCC) to improve passage and minimize adverse effects	X				X						
• Reduce reverse flows in Old River (net westward flow)	X										
• Re-operation of upstream storage facilities to improve in-stream flows and cold water pool management and to increase Delta in-flow	X			X				X			
• Opportunistic habitat restoration on channel-side of levees (no island restoration)	X	X	X	X	X	X	X	X	X	X	
• Extensive in-Delta Levee setbacks		X	x	x	X	X	X	x	X	X	
• Extensive restoration of aquatic and floodplain habitats:											
a. focused primarily on northern and eastern Delta		X	x	x	X	X		x	X	X	
b. focused Delta wide							X				
• Improve habitat conditions in locations where covered fishes are highly vulnerable to predation		X	X	X	X			X			

[2] This table summarizes the elements of each of the draft conservation strategy alternatives (CSAs). Placement of an "X" in columns indicates that the element is a component of the CSA. Placement of a "x" indicates that the element is a component of the alternative, but that it would be implemented at a smaller scale than under other alternatives that include the component.

[3] Elements to be started after alternative is fully implemented. For CSAs requiring construction of new conveyance facilities, these elements will begin after construction is completed.

1

Table D-3. Elements of Draft Conservation Strategy Alternatives (continued)

Conservation Strategy Alternative Elements	*Conservation Strategy Alternatives (CSAs)*[A]										
	Static Delta					Fluctuating Delta					
	Existing Conveyance Facilities					New Conveyance Facilities					
	1	2	6	7	3	4	5	7	8	9	10
• Manage bypasses within the Delta to improve non-flow related habitat conditions for covered fish species		X									
• Increased CVP/SWP pumping capacity to take advantage of high flow episodes with pumping limited at other times when covered species are least vulnerable to entrainment and no pumping at times they are most vulnerable to entrainment					X						
• Provide flows that improve flow-related habitat conditions that mimic historical hydrological patterns (e.g., fluctuating salinity, east-west flow)					X						
• Increased conveyance capacity south of Delta and additional south-of-Delta storage facilities and infrastructure to opportunistically store high flows, including concurrent improvements to louver facilities to minimize fish mortality					X						
• Construct and operate a peripheral aqueduct ("South Delta Aqueduct") from Sacramento River (near Hood) with state of the art screening with discharge into lower San Joaquin River						X					
• Operate the Delta to reestablish fluctuating hydrologic conditions						X	X		X		
• Construct and operate an isolated facility (IF) (i.e., "peripheral canal") from Sacramento River (near Hood) with state of the art screening directly to the pumps to isolate the Delta from CCF and the SWP/CVP pumps.							X				
• Modify DCC gate operations to maximize benefits for covered fish							X				
• Breach dikes in Suisun Marsh to reestablish tidal exchange and create tributary channels necessary to create high quality intertidal marsh and aquatic habitats			X								
• Modify operations of salinity control structures in Suisun Marsh to improve flow-related habitat conditions for covered fish in Suisun Marsh			X								
• Improving passage and access to upstream habitats				X				X			
• Restoration of spawning habitat (e.g., gravel augmentation)				X				X			
• Expansion of river floodplain habitat including creation and expansion of new floodways				X				X			

Table D-3. Elements of Draft Conservation Strategy Alternatives (continued)

Conservation Strategy Alternative Elements	*Conservation Strategy Alternatives (CSAs)*[A]										
	Static Delta				**Fluctuating Delta**						
	Existing Conveyance Facilities				**New Conveyance Facilities**						
	1	**2**	**6**	**7**	**3**	**4**	**5**	**7**	**8**	**9**	**10**
• Isolation of captured gravel pits				X				X			
• Installation of screens on river diversions				X				X			
• Removal of bank protection to reestablish floodplain processes				X				X			
• Restoration of riparian habitat including shaded riverine				X				X			
• Removal of bank protection to reestablish floodplain processes that support creation and maintenance of spawning and rearing habitat				X				X			
• Restoration of riparian habitat including shaded riverine aquatic cover				X				X			
• Modified operations to support in-stream flows for spawning and rearing, including bypass habitats, and cold water pool management				X				X			
• Construct and operate a peripheral aqueduct from the Sacramento River (near Hood) with state of the art screening that is bifurcated at the discharge end: one split discharges into the CCF and isolates the SWP and CVP pumps (smaller discharge than under CSA 5), and the other split discharges into lower San Joaquin River (smaller discharge than under CSA 4).									X		
• Limited exports continued from existing South Delta facilities									X		
• Improvements/maintenance of through Delta conveyance facilities (e.g., reinforcing levees, dredging to maintain channel capacity)										X	
• Construct and operate a peripheral aqueduct from Sacramento River (near Hood) of lesser capacity than under CSA 5 directly to the pumps to isolate the Delta from CCF and the SWP/CVP pumps										X	
• Operate the Delta to reestablish fluctuating hydrologic conditions, though not to the extent under CSA 4 and 5										X	
• Divide the Old River channel to allow San Joaquin River flow to be separated from Victoria Canal water supply flows and install structures to regulate flows such that San Joaquin River flows are separated from the pumps and allowed to pass to the central Delta.											X
• Open the DCC and install screens at the DCC and Georgiana Slough to prevent passage Sacramento River fish into the Central Delta and reconfigure in-Delta conveyance to create a water supply corridor toward the SWP and CVP using the DCC, rock barriers, floodgates, siphons, and pumps.											X

Table D-3. Elements of Draft Conservation Strategy Alternatives (continued)

Conservation Strategy Alternative Elements	*Conservation Strategy Alternatives (CSAs)*[A]										
	Static Delta				**Fluctuating Delta**						
	Existing Conveyance Facilities					**New Conveyance Facilities**					
	1	**2**	**6**	**7**	**3**	**4**	**5**	**7**	**8**	**9**	**10**
• Operate Split Delta conveyance facilities to provide transport flows for juvenile Delta smelt and improve salinity conditions for estuarine fish along the lower San Joaquin River to Franks Tract.											X
Pre-operational elements[4]											
• Limited in-Delta levee setbacks and breaching of Delta islands to restore aquatic and floodplain habitats						X	X		X	X	
• Real-time operation of CVP and SWP pumps to minimize entrainment of fish during sensitive time periods						X	X		X	X	
• Improve the SWP/CVP salvage collection, handling, transportation, and release (CHTR) processes to increase survival						X	X		X	X	
• Opportunistic habitat restoration on channel-side of levees (no island restoration)						X	X		X	X	
• Improvements to louver facilities at SWP and CVP pumps to minimize fish mortality						X	X		X	X	
• Operate the Delta Cross Channel (DCC) to improve passage of Sacramento River steelhead and salmon and minimize adverse effects on Sacramento River fish associated with moving into the Central Delta						X	X		X	X	
• Re-operation of upstream storage facilities to improve in-stream flows and cold water pool management for benefit of riverine fish and to increase Delta in-flow for benefit of estuarine fish						X	X		X	X	
• Improve habitat conditions in locations where covered fishes are highly vulnerable to predation to create habitat conditions that will reduce predation levels.						X	X		X	X	

[A] **Conservation Strategy Alternatives:**
1= CSA 1—Operations Modifications with Existing Conveyance Configuration
2 = CSA 2—In-Delta Habitat Restoration under Existing Operations
3 = CSA 3—Opportunistic Exports with In-Delta Habitat Restoration
4 = CSA 4— South Delta Aqueduct with In-Delta Habitat Restoration
5 = CSA 5—Isolated Facility with In-Delta Habitat Restoration
6 = CSA 6—Suisun Marsh Habitat Restoration in Combination with In-Delta Restoration
7 = CSA 7—Upstream Habitat Restoration in Combination with In-Delta Restoration
8 = CSA 8—Bifurcated SDA with In-Delta Restoration
9 = CSA 9—Dual Conveyance with In-Delta Restoration
10 = CSA 10—Split Delta with San Joaquin River Corridor Restoration

[4] Interim elements to be implemented during construction of new conveyance facilities for CSAs requiring this construction.

Table D-4. Bundles of Potential Conservation Elements

Water Operations and Conveyance Bundles		
***Bundle #1:* Real-time operation of CVP/SWP pumps to minimize entrainment of fish during sensitive time periods**		
1a. Operate CVP/SWP pumps in real time, based on fish monitoring data, to minimize entrainment of fish during sensitive time periods	1b. Reduce reverse flows in Old River and Middle River (net westward flow)	
***Bundle #2:* Reduced water demand and Delta diversions**		
2a. Reduced water demand and diversions from the Delta	2b. Reduce reverse flows in Old River and Middle River (net westward flow)	
***Bundle #3:* Export water opportunistically**		
3a. Increase CVP/SWP pumping capacity to take advantage of high flow episodes with pumping limited at other times when covered species are least vulnerable to entrainment and no pumping at times they are most vulnerable to entrainment	3b. Provide flows that improve flow-related habitat conditions that mimic historical hydrological patterns (e.g. fluctuating salinity, east-west flow)	3c. Increased conveyance capacity south of Delta and additional south-of-Delta storage facilities and infrastructure to opportunistically store high flows, including concurrent improvements to louver facilities to minimize fish mortality.
***Bundle #4:* Construct and Operate South Delta Aqueduct (SDA) Facilities**		
4a. Construct and operate a peripheral aqueduct ("South Delta Aqueduct") from Sacramento River (near Hood) with state of the art screening with discharge into lower San Joaquin River. Diverting water from the Sacramento River near Hood will allow salinities to fluctuate in the western, northern, and eastern Delta. Discharging Sacramento River water into the lower San Joaquin River will improve water quality conditions (e.g., dissolved oxygen) for covered species in the south Delta.	4b. Operate the Delta to reestablish fluctuating hydrologic conditions (salinity, flow, temperature) in the northern, western, eastern and central Delta that benefit covered fish species, including re-operation of upstream storage facilities to support Delta operations.	
***Bundle #5:* Construct and Operate an Isolated Facility**		
5a. Construct and operate an isolated facility (IF) (i.e., "peripheral canal") from Sacramento River (near Hood) with state of the art screening directly to the pumps to isolate the Delta from Clifton Court Forebay and the SWP/CVP pumps.	5b. Operate the Delta to reestablish fluctuating hydrologic conditions (salinity, flow, temperature) throughout the Delta that benefit covered fish species, including re-operation of upstream storage facilities to support Delta operations.	

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Table D-4. Bundles of Potential Conservation Elements (continued)

***Bundle #6:* Construct and operate a bifurcated South Delta Aqueduct (SDA)**			
6a. Construct and operate a peripheral aqueduct from the Sacramento River (near Hood) with state of the art screening that is bifurcated at the discharge end: one split discharges into the CCF and isolates the SWP and CVP pumps (smaller discharge than under Bundle #5), and the other split discharges into lower San Joaquin River (smaller discharge than under Bundle #4). Diverting water from the Sacramento River near Hood will allow salinities to fluctuate throughout the Delta. Discharging Sacramento River water into the lower San Joaquin River will improve water quality conditions (e.g., dissolved oxygen) for covered species in the south Delta.	6b. Operate the Delta to reestablish fluctuating hydrologic conditions (salinity, flow, temperature) that benefit covered fish species, including re-operation of upstream storage facilities to support Delta operations in northern, western, eastern, and central Delta.	6c. Limited exports continued from existing South Delta facilities.	
***Bundle #7:* Construct and Operate Dual Conveyance Facilities**			
7a. Improvements/maintenance of through-Delta conveyance facilities (e.g., reinforcing levees, dredging to maintain channel capacity).	7b. Construct and operate a peripheral aqueduct from Sacramento River (near Hood) of lesser capacity than under Bundle #5 directly to the pumps to isolate the Delta from Clifton Court Forebay and the SWP/CVP pumps.	7c. Operate the Delta to reestablish fluctuating hydrologic conditions (salinity, flow, temperature) that benefit covered fish species, though not to the extent under Bundle #4 and 5, including re-operation of upstream storage facilities to support Delta operations.	
***Bundle #8:* San Joaquin River Corridor isolated from through-Delta conveyance and SWP/CVP Intakes**			
8a. Divide the Old River channel to allow San Joaquin River flow to be separated from Victoria Canal water supply flows and install structures to regulate flows such that San Joaquin River flows are separated from the pumps and allowed to pass to the central Delta.	8b. Reconfigure in-Delta conveyance to create a water supply corridor toward the SWP and CVP using the Delta Cross Channel (DCC), rock barriers, floodgates, siphons, and pumps.	8c. Operate Split Delta conveyance facilities to provide transport flows for juvenile Delta smelt and improve salinity conditions for estuarine fish along the lower San Joaquin River to Franks Tract.	
Entrainment and Predation Mortality Reduction Bundles			
***Bundle #9:* Minimize fish mortality associated with entrainment at SWP/CVP intakes**			
9a. Improvements to louver facilities at SWP and CVP pumps to minimize fish mortality.	9b. Improve the SWP/CVP salvage collection, handling, transportation, and release (CHTR) processes to increase survival.	9c. Improve facilities and pumping operations to minimize passage of fish into Clifton Court Forebay (CCF).	9d. Modify in-channel habitat structure at SWP/CVP facilities to reduce conditions that support predation of native fishes.
***Bundle #10:* Minimize entrainment at non-SWP/CVP diversions**			
10a. Removal and consolidation of in-Delta diversions to minimize entrainment losses of fish.	10b. Improve the effectiveness of ineffective screened diversions within the Delta.	10c. Screen un-screened in-Delta diversions.	

Table D-4. Bundles of Potential Conservation Elements (continued)

***Bundle #11:* Improve habitat conditions in Delta locations where covered fishes are highly vulnerable to predation to create habitat conditions that will reduce predation levels.**		
Involves improving habitat conditions in Delta locations where covered fishes are highly vulnerable to predation to create habitat conditions that will reduce predation levels.		
***Bundle #12:* Isolation of captured gravel pits upstream of Delta**		
Involves the isolation of captured gravel pits upstream of Delta to reduce the mortality of salmonids and splittail.		
***Bundle #13:* Installation of screens on river diversions upstream of Delta**		
Involves the installation of screens on river diversions upstream of Delta to reduce mortality of fish.		
Flow-related Habitat Improvement Bundles		
***Bundle #14:* Operate the Delta Cross Channel (DCC) to improve passage**		
14a. Operate the DCC to improve passage of Sacramento River steelhead and salmon and minimize adverse effects on Sacramento River fish associated with moving into the Central Delta.		
***Bundle #15:* Open the DCC and install screens at the DCC and Georgiana Slough**		
Involves changes in the DCC, including opening of the DCC and installation of screens at the DCC and Georgiana Slough for the benefit of salmonids.		
***Bundle #16:* Re-operation of upstream storage facilities to improve riverine and Delta habitats**		
16a. Re-operation of upstream storage facilities for cold water pool management for benefit of riverine fish.	16b. Re-operation of upstream storage facilities to improve Delta in-flow for benefit of estuarine fish.	16c. Re-operation of upstream storage facilities to improve in-stream flows for benefit of riverine fish.
***Bundle #17:* Improvement and creation of bypass and floodway habitat (e.g. Yolo Bypass, Cosumnes Floodway)**		
17a. Manage bypasses and restore floodways within and upstream of the Delta to improve habitat.		
Physical Restoration Bundles		
***Bundle #18:* Restore physical habitat in the North, East, and West Delta**		
18a. Design in-Delta levee maintenance projects to incorporate features that improve in-channel habitat conditions (e.g., establishment of riparian vegetation on levee slopes to provide shaded riparian area (SRA) overhead cover, creation of levee benches to create shallow inter-tidal and subtidal habitat areas, incorporation of large wood debris into riprap within the intertidal and subtidal portions of the levee cross section). Actions of this measure are limited to opportunities presented by levee maintenance needs.	18b. Extensive in-Delta levee setbacks in important covered fish use areas to establish intertidal and subtidal aquatic and floodplain habitats.	18c. Extensive restoration of aquatic and floodplain habitats on existing farmed islands by breaching levees to reintroduce tidal flow and elevating island interiors to elevations that will support desired covered species habitats. Island habitats will be designed to provide a diversity of habitats to ensure that the range of habitat conditions required for covered fishes are established and to create conditions that will maximize food production. Locations of restorations depend on operations.
***Bundle #19:* Restore physical habitat in the Central Delta**		
19a. Same as 18a	19b. Same as 18b	19c. Same as 18c
***Bundle #20:* Restore physical habitat in the South Delta**		
20a. Same as 18a	20b. Same as 18b	20c. Same as 18c

Table D-4. Bundles of Potential Conservation Elements (continued)

***Bundle #21:* Restore Suisun Marsh habitat**				
21a. Breach dikes in Suisun Marsh to reestablish tidal exchange and create tributary channels necessary to create high quality intertidal marsh and aquatic habitats.		21b. Modify operations of salinity control structures in Suisun Marsh to improve flow-related habitat conditions for covered fish in Suisun Marsh.		
***Bundle #22:* Restore and provide access to spawning and rearing habitat upstream of Delta**				
22a. Restoration of salmonid spawning habitats, including gravel augmentations, providing for channel meander to enhance inputs of spawning gravels, installing barriers to separate Chinook runs.	22b. Expansion of river floodplain habitat including creation and expansion of new floodways to restore rearing habitat and splittail spawning habitat.	22c. Removal of bank protection to reestablish floodplain processes that support creation and maintenance of spawning and rearing habitat.	22d. Restoration of riparian habitat including shaded riverine aquatic cover.	22e. Improving passage and access to upstream habitats, including removing, modifying, or bypassing barriers.

The bundles were then evaluated in the report based on four classes of 17 short-listing criteria developed by the Conservation Strategy Workgroup (Table D-5). The four classes were: Biological Criteria; Planning Criteria; Flexibility/Durability/Sustainability Criteria; and Other Resource Impacts Criteria.

Table D-5. Short-listing Criteria Applied to "Bundles" of Conservation Elements

Biological Criteria	
1	Relative degree to which the bundle would reduce species mortality attributable to non-natural mortality sources, in order to enhance production (reproduction, growth, survival), abundance, and distribution for each of the covered fish species (BDCP Conservation Objective).
2	Relative degree to which the bundle would provide water quality and flow conditions necessary to enhance production (reproduction, growth, survival), abundance, and distribution for each of the covered fish species (BDCP Conservation Objective).
3	Relative degree to which the bundle would increase habitat quality, quantity, accessibility, and diversity in order to enhance and sustain production (reproduction, growth, survival), abundance, and distribution; and to improve the resiliency of each of the covered species' populations to environmental change and variable hydrology (BDCP Conservation Objective).
4	Relative degree to which the bundle would increase food quality, quantity, and accessibility (e.g., phytoplankton, zooplankton, macro-invertebrates, forage fish) to enhance production (reproduction, growth, survival) and abundance for each of the covered fish species (BDCP Conservation Objective).
5	Relative degree to which the bundle would reduce the abundance of non-native competitors and predators to increase native species production (reproduction, growth, survival), abundance and distribution for each of the covered fish species (BDCP Conservation Objective).
6	Relative degree to which the bundle improves ecosystem processes in the BDCP planning area to support aquatic and associated habitats (BDCP Conservation Objective).
7	Relative degree to which the bundle can be implemented within a timeframe to meet the near-term needs of each covered fish species (post BDCP authorization).
Planning Criteria	
8	Relative degree to which the bundle allows covered activities to be implemented in a way that meets the goals and purposes of those activities.
9	The relative feasibility and practicability of the bundle, including the ability to fund, engineer, and implement.
10	Relative costs (including infrastructure, operations, and management) associated with implementing the bundle.
Flexibility/Durability/Sustainability Criteria	
11	Relative degree to which the bundle will be able to withstand the effects of climate change (e.g., sea level rise, changes in runoff), variable hydrology, seismic events, subsidence of Delta islands, and other large-scale changes to the Delta.
12	Relative degree to which the bundle could improve ecosystem processes that support the long term needs of each of the covered species and their habitats with minimal future input of resources.
13	Relative degree to which the bundle can be adapted to address needs of covered fish species over time.
14	Relative degree of reversibility of the bundle once implemented.
Other Resource Impacts Criteria	
15	Relative degree to which the bundle avoids impacts on the distribution and abundance of other native species in the BDCP Planning Area.
16	Relative degree to which the bundle avoids impacts on the human environment.
17	Relative degree of risk of the bundle causing impacts on sensitive species and habitats in areas outside of the BDCP Planning Area.

These short-listing criteria were developed based on:

- The BDCP Planning Agreement (October 2006) (i.e., the Planning Agreement Planning Goals [section 3] and Preliminary Conservation Objectives [section 6]);
- The draft BDCP Conservation Objectives approved by the Workgroup and BDCP Steering Committee; and
- Previously developed criteria for evaluating approaches to conserving the Delta (Mount *et al*. 2006).

This evaluation was conducted for fish species identified as covered species in the BDCP Planning Agreement. The criteria were applied using the professional judgment of experts - including information developed in technical sessions of BDCP biologists addressing fish stressors and conservation elements - based on the present understanding of how the Bay-Delta ecosystem operates. The bundles were compared to each other as to their relative effectiveness and to existing conditions in the Delta under existing operations. Many, but not all, bundles were compatible with each other; a compatibility analysis table of the bundles was prepared to assist the Workgroup in combining the elements into cohesive, logical CSOs. Application of the criteria was intended to provide an assessment of the relative effectiveness of the bundles of elements in meeting the criteria. Based on the analysis of bundled conservation elements, the Conservation Strategy Workgroup combined sets of conservation elements to create a short list of CSOs. A short-list of four CSOs was identified and is discussed in the next section.

Table D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species

Effects Categories

B-L● = low beneficial effects at population level

B-M●● = moderate beneficial effects at population level

B-H ●●● = high beneficial effects at population level

A-L○ = low adverse effect at population level

A-M○○ = moderate adverse effects at population level

A-H ○○○ = high adverse effects at population level

NE = negligible or no effect

U = unknown

Certainty Categories

☐ **C-L** = low level of certainty regarding assessment of bundle outcomes

☐☐ **C-M** = moderate level of certainty regarding assessment of bundle outcomes

☐☐☐ **C-H** = high level of certainty regarding assessment of bundle outcomes

Conservation Element Bundles	COVERED FISH SPECIES							
	Smelt		*Sturgeon*		*Salmonids*		*Sacramento Splittail*	
	Effect	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**
Water Operations and Conveyance Bundles								
1. Real-time operation of CVP/SWP	**B-L ●** Low benefit associated with reduction in entrainment loss	**□□□ C-H**	**NE** Negligible benefit associated with reduction in entrainment loss, but because relatively few sturgeon are entrained, the level of population benefit would be minimal	**□□□ C-H**	**B-L ●** Low benefit to more common salmonids; moderate benefit to less common salmonids associated with reduction in entrainment loss; Benefits depend in part on frequency, magnitude, and duration of export reductions	**□□□ C-H**	**B-L ●** • Low benefit associated with reduction in entrainment loss in most years	**□□□ C-H**

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D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES							
	Smelt		*Sturgeon*		*Salmonids*		*Sacramento Splittail*	
	Effect	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**
2. Reduced demand/Delta diversions	**B-M** ●● Potential beneficial effects associated with reduced mortality from entrainment, improvements to water quality and flow conditions, increased food availability and quality, and improved ecosystem processes Benefits are dependent on the amount of reduction	□□ **C-M**	**NE** Largely unknown, but probably minimally positive	□ **C-L**	**B-M** ●● Low benefits from improved water quality and flow conditions Moderate benefit to less common salmonids associated with reduction in entrainment loss; low benefit to more common salmonids Benefits are dependent on magnitude and seasonal timing of reduction	□□□ **C-H**	**B-M** ●● Benefits through increased water quantity and quality, but minimized by high tolerance to environmental conditions	□□□ **C-H**
3. Opportunistic exports	**B-L** ● Low benefit associated with reduction in entrainment loss, hydrologic conditions, habitat quality and availability, food availability, and ecosystem processes Low adverse effect associated with reducing mortality of non-native competitors and predators Benefits are dependent on the hydrologic conditions, time of year, magnitude, and duration	□□ **C-M**	**B-M** ●● Low benefit associated with reduction in entrainment loss and reduction in non-native predators Low to moderate benefit associated with altering flows to mimic historic hydrologic conditions, and improved spawning habitat quantity and quality	□□ **C-M**	**B-M** ●● Moderate benefit to less common salmonids associated with reduction in entrainment loss; low benefit to more common salmonids Moderate benefits associated with improved habitat quantity Potentially high benefit associated with upstream flow modifications causing improved water quality, flow conditions, and ecosystem processes, and increased food supply, but depends on time of year exporting occurs Relative benefits should be greater for fall-run than spring- and winter-run due to interactions	□□ **C-M**	**B-M** ●● Low benefit from reduction in entrainment mortality and improved water quality, and reduced non-native competitors and predators Moderate benefit associated with increased spawning and juvenile rearing habitat quality and quantity, increase food availability, and ecosystem processes	□□ **C-M**

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES			
	Smelt	***Sturgeon***	***Salmonids***	***Sacramento Splittail***
	Effect **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**
			effects between seasonal flows and requirements for cold-water spawning	
4. SDA facility	**B-M** ●● □□ **C-M** Low to moderate benefit associated with reduced entrainment loss, quality and availability of habitat and food, reduction in non-native competitors and predators, and improved ecosystem processes Moderate benefit associated with improved hydrodynamics Long period required to implement relative to species needs Benefits are dependent on the hydrologic conditions, hydraulic residence time, channel velocities, time of year, location, magnitude, and duration	**A-L** ○ □ **C-L** Low positive effect associated with improved flow conditions, accessibility to spawning and juvenile rearing habitat, and reduction in non-native predators Potentially low to moderate adverse effect associated with false attraction flows	**B-M** ●● □□ **C-H** Potential adverse effect associated with increased entrainment from two intakes (performance of a new fish screen is unknown), but low effect on overall population Moderate benefit associated with reduced non-native competitors/predators and increased food quality, quantity, and availability High benefit associated with upstream flow modifications and more natural flows causing improved water quality, rearing habitat, and ecosystem processes Potentially high adverse effect associated with false attraction flows	**B-M** ●● □□□ **C-H** Adverse effect from increased entrainment associated with two intakes, but low effect on overall population Moderate to high benefit associated with improved water quality and flow conditions, increase in habitat, increased food availability, reduction in non-native competitors and predators, and ecosystem processes Improved conditions not expected in south Delta because low salinity must be maintained

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES			
	Smelt	***Sturgeon***	***Salmonids***	***Sacramento Splittail***
	Effect Certainty	**Effect Certainty**	**Effect Certainty**	**Effect Certainty**
5. Isolated facility	**B-H ●●● □ C-L** Low benefits associated with improved habitat diversity, quality, and availability High benefit associated with virtual elimination of entrainment losses, improvements to hydrodynamic conditions, increased food availability, and increased ecosystem processes Long period required to implement relative to species needs	**B-M ●● □ C-L** Low benefit associated with entrainment loss and reduction in non-native predators Moderate benefits associated with increased quality and access to spawning and juvenile rearing habitat, food quantity and quality	**B-H ●●● □□ C-M** Low benefit associated with reduced entrainment mortality High benefit associated with improved water quality, flow conditions, increased quality and quantity of habitat and migration corridors, increased quantity, quality, and availability of food, and ecosystem processes	**B-H ●●● □□□ C-H** Low benefit associated with reduced entrainment mortality Moderate benefit associated with reduced non-native competitors and predators High benefit associated with improved water quality and flow conditions, increased habitat and food quality, quantity, and accessibility, and improved ecosystem processes
6. Bifurcated SDA facility	**D.2.3 B-M ●● D.2.4 □ C-L** Low benefits associated with improved hydrologic conditions, increased habitat diversity, complexity, quality, and availability High benefits associated with increased food availability and improved ecosystem processes Long period required to implement relative to species needs	**D.2.5 B-L ● D.2.6 □ C-L** Low to moderate beneficial effects associated with reduced mortality, improved flow conditions to improve access to spawning and juvenile rearing habitat, and reduction in non-native predators Potentially low adverse effect associated with false attraction flows (false migration cues)	**D.2.7 B-M ●● D.2.8 □□ C-M** Low benefit associated with reduced entrainment mortality Moderate benefits associated with reductions of non-native competitors/predators High benefits associated with improved water quality and flow conditions, higher quality and quantity of juvenile rearing habitat and migration corridors, increased food quality, quantity, and availability, and improved ecosystem processes Potentially high adverse effect associated with false attraction	**D.2.9 B-M ●● D.2.10 □□□ C-H** Low adverse effect associated with increased entrainment from two intakes Low benefit associated with reduction in non-native competitors and predators Moderate beneficial impact associated with improved water quality High beneficial effects associated with increased habitat and food quality, quantity, and availability, and ecosystem processes

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES							
	Smelt		*Sturgeon*		*Salmonids*		*Sacramento Splittail*	
	Effect	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**
					flows			
7. Dual conveyance facility	**B-M** ●● Low benefit associated with improved water quality and flow conditions, increased habitat quality and availability, Moderate improvements to food availability and ecosystem processes Potentially high adverse effect from not being implemented within a time frame needed for the species	□□ **C-M**	**A-L** ○ Low benefit associated with reduced entrainment mortality, based on relative use of IF vs. South Delta facilities, and reduction in non-native predators Low to moderate benefit effect associated with fluctuating hydrologic conditions, improved access to spawning and juvenile rearing habitat, reduced water quality and food supply Dredging would cause adverse effects on water quality	□ **C-L**	**B-M** ●● Low benefit associated with reduced entrainment mortality Moderate benefits associated with increased food quality, quantity, and availability, reductions in non-native competitors and predators (but less than #5) High benefits associated with improved water quality and flow conditions, increased quality and quantity of rearing habitat and migration corridors (though lower than #5 due to dredging and levee reinforcement)	□□ **C-M**	**B-L** ● Low benefit associated with reduced mortality from entrainment and non-native mortality, increased water quality Low adverse effect associated with reduced flow conditions and water residence time leading to reduced food quantity Moderate benefit associated with increased habitat quantity, quality and accessibility	□□□ **C-H**
8. SJR corridor isolated	**A-L** ○ Low adverse effect associated with increased entrainment, reduced hydrologic residence times, and reduced ecosystem processes Low benefit associated with food availability Potentially high adverse effect from not being implemented within a time frame needed for the species	□□ **C-M**	**U** Not enough known about sturgeon to evaluate effects, but possible increase in entrainment and decrease in habitat quality and food quantity	□ **C-L**	**B-L** ● Low benefit associated with increased food quantity and improve conditions for salmonids emigrating from San Joaquin River system	□□□ **C-H**	**NE** Low adverse effects associated with reduced habitat quality and food production from reduced water residence time Low benefit associated with reduced mortality from entrainment Moderate benefit associated with increased food supply	□□□ **C-H**
Entrainment and Predation Mortality Reduction Bundles								
9. Minimize SWP/CVP	**NE** Low benefit associated with	□□ **C-M**	**U** Not enough known about	□ **C-L**	**NE** Low benefit from reduced	□□□ **C-H**	**NE** Low benefit associated with	□□□ **C-H**

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES			
	Smelt	***Sturgeon***	***Salmonids***	***Sacramento Splittail***
	Effect **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**
mortality	reduced mortality from entrainment Low adverse effect associated with reduced mortality of non-natives	sturgeon to evaluate effects, but possible decrease in entrainment	predation by non-natives in CCF Low adverse effect associated with reduction in non-native predators	reduced mortality from entrainment Low adverse effect of reduced mortality of non-natives
10. Minimize non-SWP/CVP entrainment	**B-L** ● □□ **C-M** Low benefit associated with reduced mortality from entrainment, increased food quality and availability, and improved ecosystem processes Moderate benefit associated with improved hydrodynamic conditions and water quality if diversions are consolidated/ removed Low adverse effect associated with reduced non-native mortality from entrainment	**B-L** ● □□ **C-M** Low benefit associated with reduced mortality from entrainment	**NE** □□□ **C-H** Likely minimal benefit associated with reduced entrainment Low adverse effect of reduced mortality of non-native predators/competitors	**NE** □□□ **C-H** Low benefit associated with reduced mortality from entrainment Low adverse effect of reduced mortality of non-native predators/competitors
11. Improve habitat to reduce predation	**B-L** ● □ **C-L** Low benefit associated with reduced mortality from predation by non-natives, water quality and hydrologic conditions	**U** □ **C-L** Not enough known about sturgeon to evaluate effects, but possible marginal benefit by reducing predator abundance	**B-L** ● □□ **C-M** Low benefit associated with reduced predation by non-natives, higher habitat quantity and quality, but dependent on amount of improvements	**B-M** ●● □□□ **C-H** Marginal benefit associated with increased shallow water habitat Moderate beneficial effect associated with reduced predation
12. Isolate gravel pits	**NE** □□□ **C-H** Outside of species habitat	**NE** □□□ **C-H** Ongoing sampling indicates captured gravel pits are not a stressor on green or white sturgeon	**B-L** ● □□ **C-M** Low benefits associated with reduced predation by non-natives Benefits will be greatest on San	**B-L** ● □□□ **C-H** Low benefit associated with reduced predation by non-natives and marginal increase in shallow habitat

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES			
	Smelt	***Sturgeon***	***Salmonids***	***Sacramento Splittail***
	Effect **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**
			Joaquin, where majority of gravel pits are located	
13. Install screens on upstream diversions	**NE** □□□ **C-H** Outside of species habitat	**NE** □□ **C-M** Negligible benefit associated with reduced entrainment loss	**NE** □□ **C-M** Negligible benefit associated with reduced entrainment loss, but expected to be minimal	**NE** □□□ **C-H** Positive effects of reduced entrainment would be cancelled out by adverse effects of reduced entrainment of predators and competitors
Flow-Related Habitat Improvement Bundles				
14. Operate DCC to improve passage	**NE** □□ **C-M** Marginal benefit associated with reduced non-native predator habitat, but expected to be negligible	**NE** □□ **C-M** DCC gates are currently open during juvenile outmigration period, so no additional benefit	**NE** □□□ **C-H** Gates are already operated to minimize outmigrating salmonid mortality; therefore, effects are minimal	**B-L** ● □□□ **C-H** Low benefit associated with increased water quality and flow conditions from closed gates
15. Open DCC & install screens at DCC & Georgiana Slough	**NE** □□ **C-M** Potential marginal benefit associated with reduced non-native predator habitat	**A-L** ○ □□ **C-M** Low to moderate adverse effects associated with reduced access to food and habitat in the interior Delta	**B-M** ●● □□ **C-M** Moderate benefit associated with higher survival from reduced passage into interior Delta Low adverse effects associated with reduced water quality and flow conditions in interior Delta	**A-L** ○ □□□ **C-H** Low adverse effects associated with reduced water quality, flow conditions and increased toxics Negligible adverse effect associated with reduced access to food in interior Delta
16. Re-operate upstream storage facilities	**NE** □□ **C-M** Outside of species habitat	**B-M** ●● □□ **C-M** Moderate positive effect associated with increased water quality, creation of attraction flows, barrier passage flow, and improved habitat quality and quantity	**B-M** ●● □□ **C-M** Moderate benefit associated with increased water quality and flow conditions, increased habitat quantity, and ecosystem processes Potentially low to moderate benefit associated with increased food quality and reduced non-native species	**B-H** ●●● □□□ **C-H** Low positive effects associated with increased food quality and quantity and reduction of non-native competitors and predators Moderate positive effects associated with increase water quality and flow conditions High positive effects associated

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES			
	Smelt	***Sturgeon***	***Salmonids***	***Sacramento Splittail***
	Effect **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**	**Effect** **Certainty**
				with increased accessibility to spawning habitat and improved ecosystem processes
17. Improve and create bypass and floodway habitat	**NE** □□ **C-M** Outside of species habitat	**B-M** ●● □□ **C-M** Low to moderate benefits associated with reductions in non-natural mortality, improved water quality, improved availability of habitat, and improved food quality and quantity	**B-M** ●● □□□ **C-H** Moderate benefits associated with reduced abundance of non-natives competitors and predators, increased habitat quantity, increased food quality and quantity, and improved ecosystem processes	**B-H** ●●● □□□ **C-H** High benefits associated with food and habitat quality, quantity, and accessibility, and improved ecosystem processes
Physical Habitat Restoration Bundles				
18. Restore habitat in the north, east, and west Delta	**B-H** ●●● □□ **C-L** Low benefit associated with improved water quality and hydrologic conditions High benefit associated with improved habitat quality, availability, and complexity, and ecosystem processes Potential high benefit associated with increased food availability, but largely unknown	**B-H** ●● □□ **C-M** Moderate to high benefits associated with increased quantity, quality, quantity, and availability of habitat and food	**B-L** ● □□ **C-M** Low benefits from reduced mortality from non-natives, increased food quantity, improved habitat quality and quantity, and improved ecosystem processes	**B-H** ●●● □□□ **C-H** Low benefits associated with reductions of non-natives Moderate benefits associated with improved water quality High benefits associated with increased quality, quantity, and accessibility in habitat and food and improved ecosystem processes
19. Restore habitat in the central Delta	**B-H** ●●● □ **C-L** Similar to but lower benefits than #18 and #21 because central Delta has lower value to smelt than north Delta and Suisun Marsh, but greater than #20 because central Delta has higher value to smelt than south Delta	**B-M** ●● □□ **C-M** Moderate to high benefits associated with increased quantity, quality, quantity, and availability of habitat and food	**B-L** ● □□ **C-M** Benefits similar to #18, but lower because fewer salmonids pass through central Delta	**B-M** ●● □□□ **C-H** Similar to but lower benefits than #18 because smaller area and less desirable habitat for splittail

D-6. Summary Evaluation of BDCP Conservation Element Bundles by Covered Fish Species (continued)

Conservation Element Bundles	COVERED FISH SPECIES							
	Smelt		*Sturgeon*		*Salmonids*		*Sacramento Splittail*	
	Effect	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**	**Effect**	**Certainty**
20. Restore habitat in the south Delta	**B-M ●●** Similar to but lower benefits than #18, #19, #21 because south Delta has lower value to smelt than north Delta, central Delta, and Suisun Marsh	**□ C-L**	**B-L ●** Similar to but lower benefits than #18 & 19 because sturgeon enter Delta from the north	**□ C-L**	**B-L ●** Benefits similar to #18, but lower because only steelhead and fall-run salmonids are in San Joaquin River	**□□ C-M**	**B-M ●●** Similar to but lower benefits than #18 because smaller area and less desirable habitat for splittail	**□□□ C-H**
21. Restore Suisun Marsh habitat	**B-H ●●●** Similar benefits to #18, but greater than #19 & #21 because Suisun Marsh has higher value to smelt than south and central Delta	**□ C-L**	**B-L ●** Low benefits associated with improved water quality, flow conditions and increased habitat availability, increased food availability	**□ C-L**	**B-L ●** Low benefits from reduced mortality from non-natives, increased food quantity, improved habitat quality and quantity, and improved ecosystem processes	**□□□ C-H**	**B-H ●●●** Low beneficial effects associated with reduced non-native competitors and predators Moderate benefits associated with reduced mortality, increase water quality and flow conditions High benefit associated with increased habitat quantity, quality, and availability for juveniles and adults	**□□ C-M**
22. Restore habitat upstream of Delta	**NE** Outside of species habitat	**□□ C-M**	**B-M●●** Low to moderate benefits associated with improved water quality, Moderate benefits associated with improved access to and quantity of spawning habitat, increased food supply	**□□ C-M**	**B-H ●●●** High benefits associated with reduced mortality from non-native predators, improving hydrologic conditions, increased quantity, quality, and accessibility of habitat, increased food supply, improved ecological processes	**□□□ C-H**	**B-H ●●●** High benefits specifically from floodplain restoration (similar to #17)	**□□□ C-H**

D.2.11 Short-List of Four Conservation Strategy Options

Based upon the bundles analysis described above, the Conservation Strategy Workgroup recombined the elements to create a short list of four new, comprehensive CSOs and these were recommended by the Workgroup to the Steering Committee to approve for further analysis. As described in the BDCP Points of Agreement for Continuing into the Planning Process (discussed below), each of the four CSOs was focused on two key issues: approaches to the conveyance of water and restoration of aquatic habitats. These options were subjected to a more in-depth analysis of their relative capacities to achieve the planning goals and conservation objectives of the BDCP. The four options consisted of the following:

- **Option 1** involved the use of existing conveyance and export facilities and restoration actions targeted in Suisun Marsh and the north and west Delta.
- **Option 2** focused on improvements to through-Delta water conveyance and for habitat restoration actions targeted in Suisun Marsh and the north, west, and south-central Delta.
- **Option 3** involved a dual-conveyance approach, which contemplated improved through-Delta conveyance and a new diversion to be located on the Sacramento River that would convey water around the Delta to the existing south Delta CVP and SWP pumping facilities. Habitat restoration would be focused in Suisun Marsh and the north, west, and south-central Delta.
- **Option 4** included the establishment of new points of diversion on the Sacramento River that would enable water to be conveyed around the Delta to the existing south Delta CVP and SWP pumping facilities. Habitat restoration would occur in Suisun Marsh and throughout the Delta.

After being approved by the Steering Committee, the short list of four CSOs was analyzed in detail to determine their likely benefits and practicability. In early September 2007, the consultant team provided the Steering Committee a report entitled the "BDCP Conservation Strategy Options Evaluation" (Options Evaluation) (SAIC 2007b), which provided an analysis of the four options. The report set out the results of the analysis of the four options, providing the Steering Committee with the information it needed to select an option to carry forward into the planning process. This report provided a largely qualitative assessment of the opportunities and constraints of each of the options relative to the planning goals and conservation objectives. The report evaluated each of the four options using the same four groups of 17 criteria (e.g, biological criteria, planning criteria, flexibility/durability/sustainability criteria) used in the bundles evaluation (Table D-5). The report analyzed the potential of each of the four options to affect each of the 17 criteria in comparison to a base condition (which approximated current biological and hydrodynamic conditions) and to each of the other options.

The evaluation of the options was based primarily on the results of hydrodynamic modeling (using CALSIMII and DSM2) and on the opportunities for habitat restoration afforded by each. To conduct the modeling, the Steering Committee directed its consultant team to identify a range

of water operational values, represented by two scenarios, which were used as key model input parameters. Results for each of the scenarios provided the Steering Committee with information relating to the relative flexibility of each option to meet habitat conservation and water supply objectives.

The purpose of the Options Evaluation was to assist the Steering Committee in better understanding the implications – positive and negative – of each of the four options and their potential capacity to meet overall BDCP goals and objectives.

The Options Evaluation concluded that each option offered opportunities and constraints to meeting conservation and water supply goals. The summary conclusion of the report was that both Options 3 and 4 appear to provide significant improvements over the Options 1 and 2 across the biological, planning and flexibility criteria, though Options 3 and 4 score less well in the other resource impacts category.

Option 3 appeared to perform better than all other options in its ability to meet water supply planning goals and objectives, and in its resiliency in response to catastrophic events. Its performance biologically is consistently superior to Options 1 and 2, but is less robust than Option 4. Its dual conveyance feature may provide significant operational flexibility over and above the other options.

Option 4 appeared to provide the greatest opportunity to meet the greatest number of criteria. It allows for the most opportunities over a much larger proportion of the Delta to combine the restoration of natural hydrology beneficial to covered fish species with the restoration of physical habitat for those species. It separates geographically and hydrologically the frequently conflicting requirements (structural and operational) of export water conveyance and aquatic species conservation (allowing for the greatest flexibility in accomplishing habitat conservation). A key constraint of Option 4 is the limitation of export capabilities to a single north Delta intake – a limitation which affects both water supply reliability and Delta inflows for conservation.

Figures D-11 through D-14 depict the options and Tables D-7, D-8, and D-9 provide a summary of the comparison of options from the Options Evaluation (SAIC 2007b).

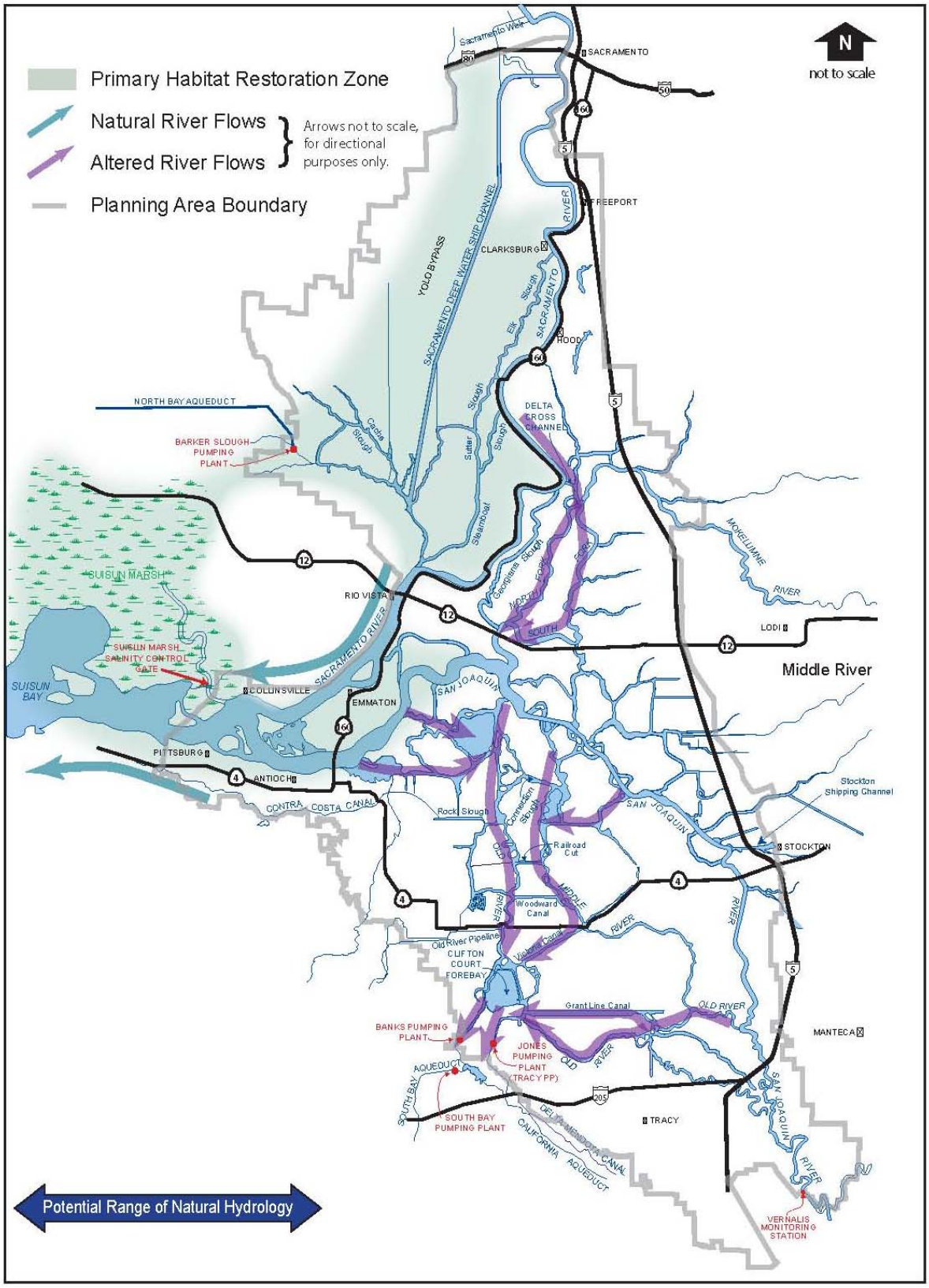


Figure D-11. Conservation Strategy Option 1

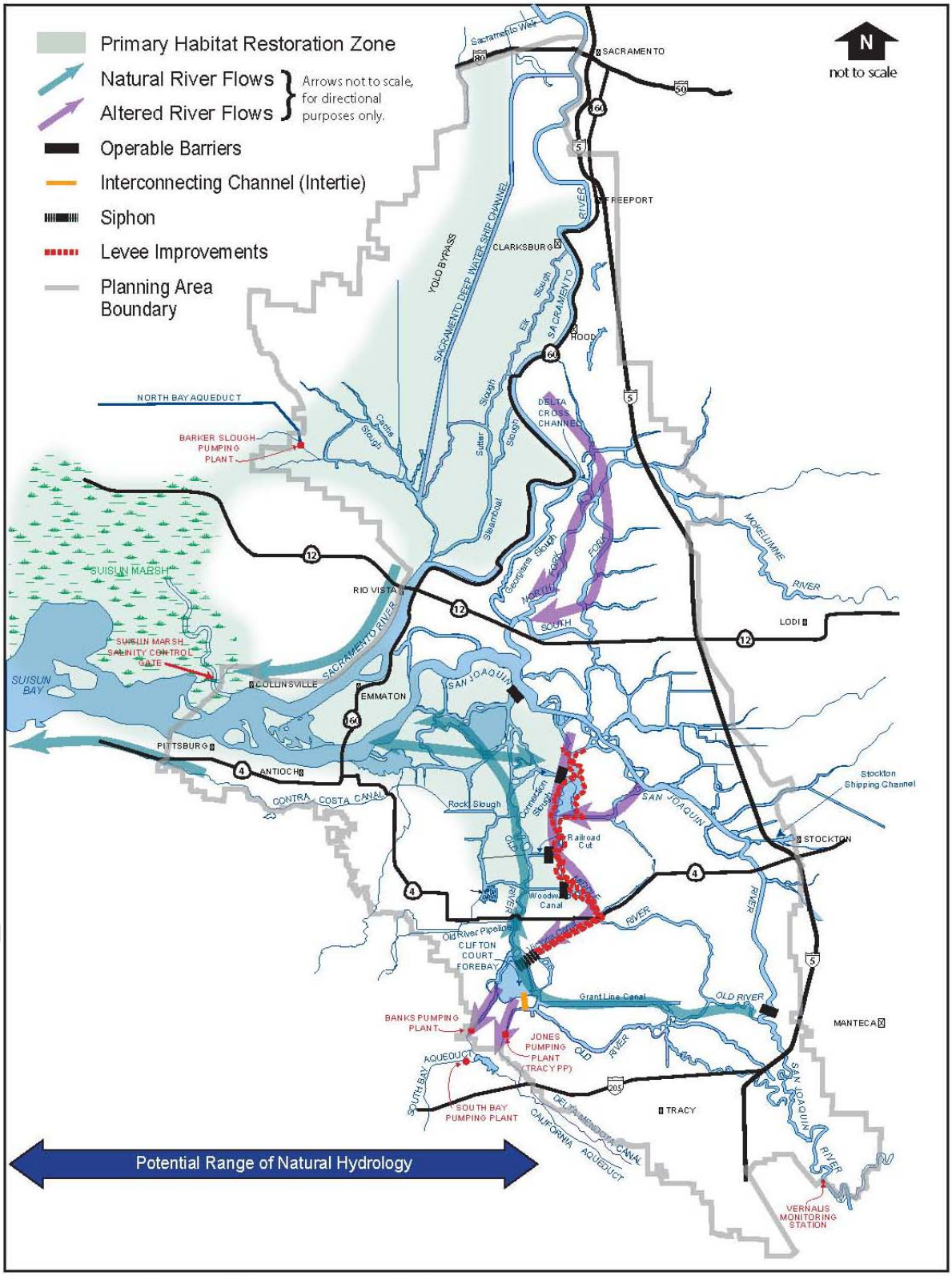


Figure D-12. Conservation Strategy Option 2

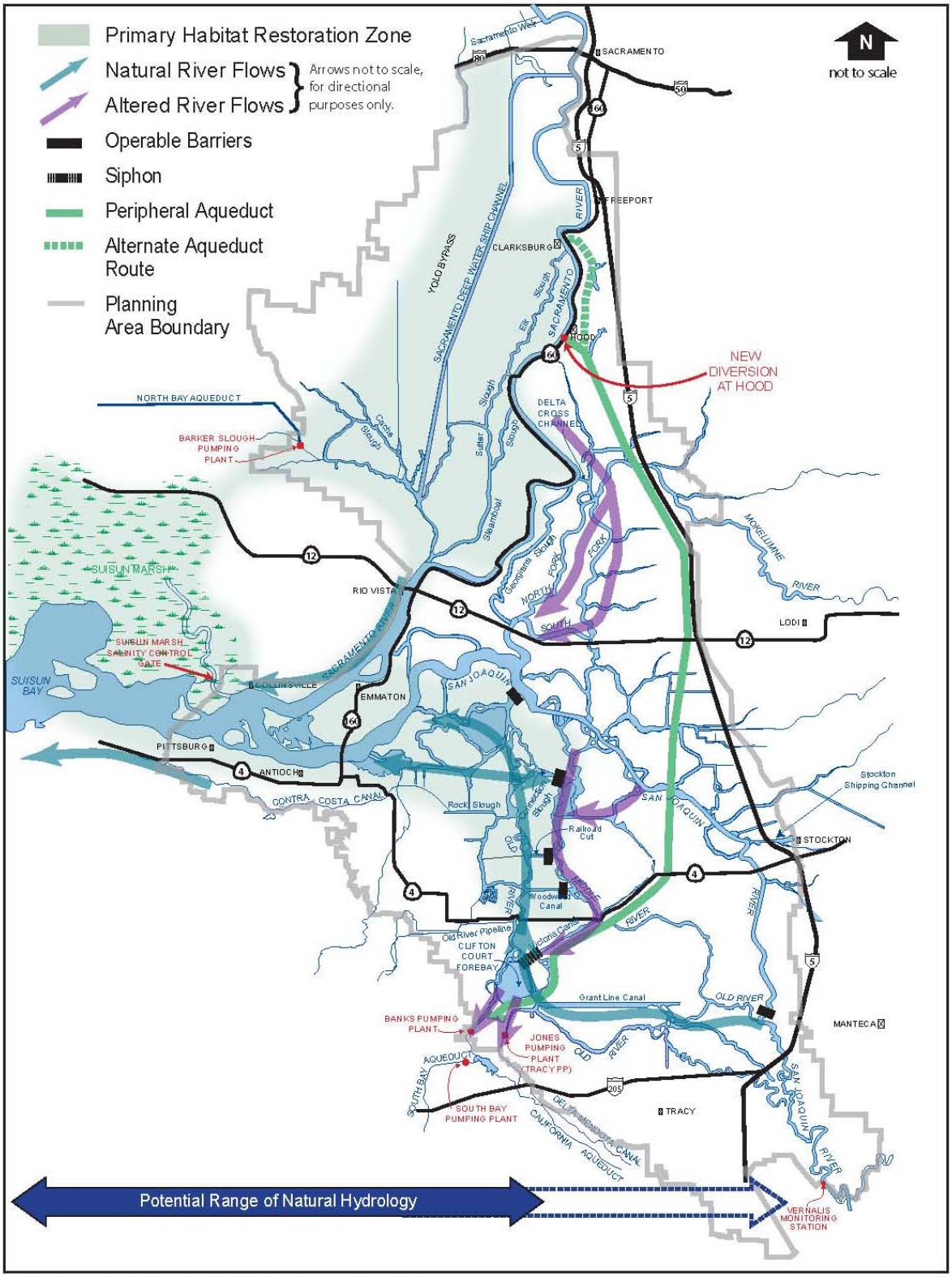


Figure D-13. Conservation Strategy Option 3

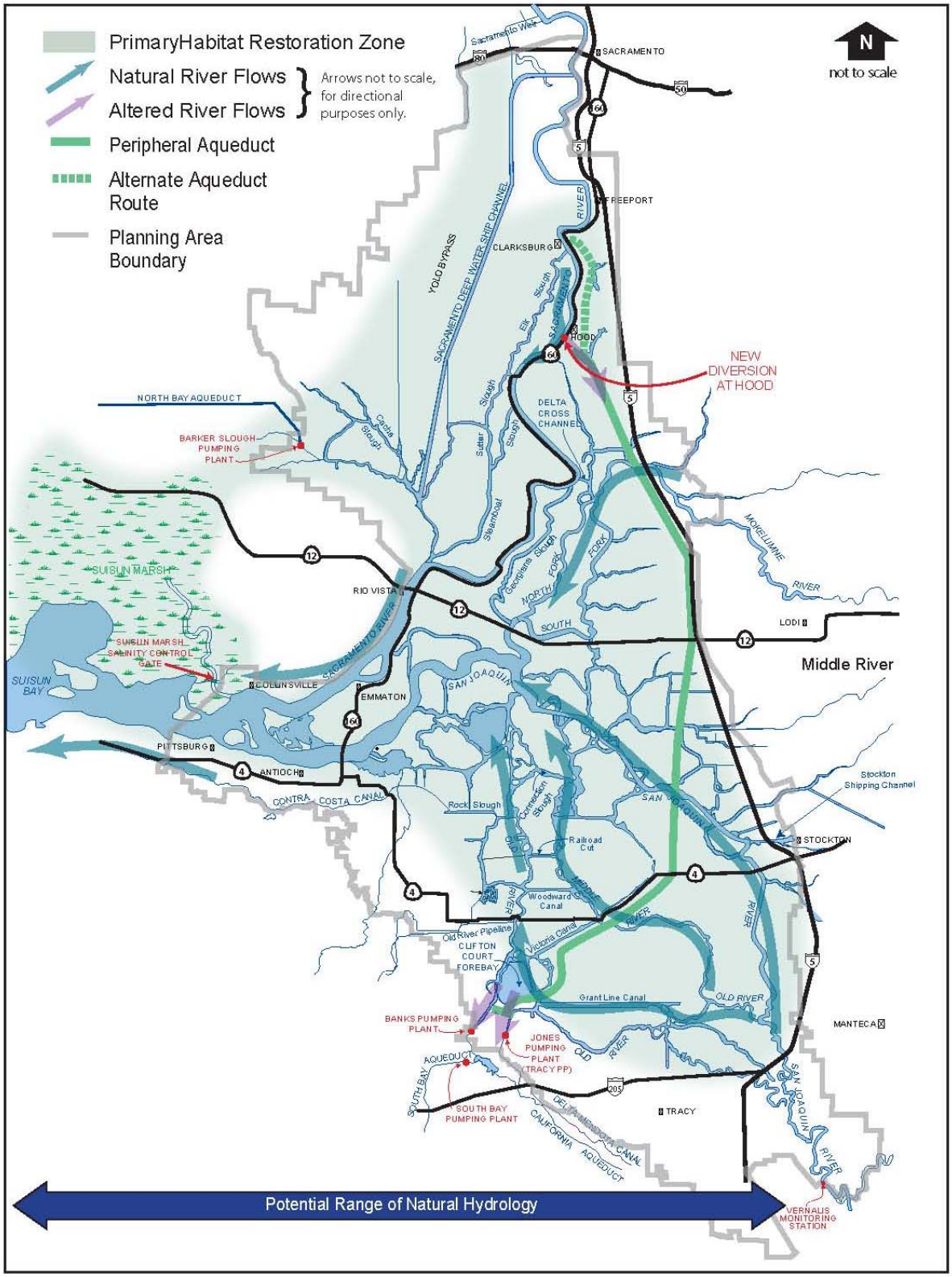


Figure D-14. Conservation Strategy Option 4

Table D-7. Comparison of Options by Covered Fish Species

Species	*Performance Rank*[1]			
	Option 1	**Option 2**	**Option 3**	**Option 4**
Delta smelt	●	●●	●●●	●●●●
Longfin smelt	●	●●	●●●	●●●●
Sacramento River Salmonids	●●●	●●●	●●●	●●●●
San Joaquin River Salmonids	●	●●	●●●	●●●●
White Sturgeon	●	●●●	●●●	●●●●
Green Sturgeon	●●●	●●●	●●●	●●●●
Sacramento splittail	●●	●●	●●●	●●●●

[1]Based on information presented in Tables H-1 to H-9 of the BDCP Conservation Strategy Options Evaluation Report addressing Biological Criteria #1-7.

Species performance ranks are:

- ●●●● = Best performing,
- ●●● = Second best performing,
- ●● = Third best performing,
- ● = Lowest performing

Where ranks are equal ,the two options receive same rank

Table D-8. Comparison of Options by Planning, Feasibility/ Durability/Sustainability, and Other Resource Impacts Criteria

Criterion	*Performance Rank*[1]			
	Option 1	**Option 2**	**Option 3**	**Option 4**
Planning Criteria				
8. Water supply goals	●●	●	●●●●	●●●
9. Feasibility/practicability	●●●●	●●●●	●●●●	●●●●
10. Minimize cost	●	●●	●●●	●●●●
Flexibility/Sustainability/Durability Criteria				
11. Durability to catastrophic events	●	●●	●●●●	●●●
12. Minimize ongoing resource input for long-term conservation	●	●●	●●●	●●●●
13. Flexibility/adaptability	●	●●	●●●	●●●●
14. Reversibility	●●●●	●●●	●●	●●
Other Resource Impacts Criteria				
15. Avoidance of impacts on other native species (in-Delta)	●●●●	●●	●	●●●
16. Avoidance of impacts on human environment (in-Delta)[2]	●●●●	●●●	●	●●
17. Avoidance of impacts on native species (outside Delta)	●●	●●	●●●●	●●●

[1]Derived from information presented in Sections 7.2, 7.3, and 7.4 of the BDCP Conservation Strategy Options Evaluation Report.
[2]Does not include indirect effects in export service areas.

Criteria performance ranks are:

- ●●●● = Best performing,
- ●●● = Second best performing,
- ●● = Third best performing,
- ● = Lowest performing

Where ranks are equal, the two options receive same rank

1
2

Table D-9. Overall Comparison of Options by Criteria Category (Rank)[1]

Evaluation Criteria Category	*Conservation Strategy Option*			
	Option 1	**Option 2**	**Option 3**	**Option 4**
Biological	●	●●	●●●	●●●●
Planning	●	●	●●●●	●●●●
Flexibility/ Sustainability/Durability	●	●●	●●●	●●●●
Impacts on Other Resources	●●●●	●●●	●	●●

[1]Derived from information presented in Tables 7-1 and 7-2 of the BDCP Conservation Strategy Options Evaluation Report.
Criteria performance ranks are:
●●●● = Best performing
●●● = Second best performing;
●● = Third best performing
● = Lowest performing
Where ranks are equal, the two options receive same rank

D.3 BDCP POINTS OF AGREEMENT FOR CONTINUING INTO THE PLANNING PROCESS

In November of 2007, the Steering Committee prepared the *Bay Delta Conservation Plan Points of Agreement for Continuing into the Planning Process* that identified key points of agreement. The Steering Committee agreed that the BDCP would include the following elements, which would be further developed, analyzed and improved upon (refer to the Points of Agreement for more information).

- **Habitat Restoration and Enhancement** - The BDCP would include a habitat restoration and enhancement program designed to increase the quality and quantity of habitat and otherwise help achieve the conservation objectives for covered species, enabled in part by improvements to conveyance over the near and long term. Initial habitat restoration and enhancement efforts would be directed toward areas that offer the greatest conservation opportunities, such as in Suisun Marsh and in the north and west Delta. Completion of a new Sacramento River intake and isolated conveyance facilities was expected to change the hydrodynamic conditions in the Delta in a manner that would likely afford new opportunities for habitat restoration and enhancement in various other parts of the Delta.

  The types of habitat restoration and enhancement actions initially evaluated for inclusion in the conservation strategy included:

  - Restoring intertidal habitat to establish vegetated marshes and associated sloughs to increase habitat diversity and complexity, food production and in-Delta productivity, and rearing habitat for covered species.
  - Increasing hydraulic residence time and tidal exchange within the Delta sloughs and channels by changing circulation patterns to increase primary productivity and food web support and improve turbidity conditions for Delta smelt and longfin smelt.

- Increasing the amount of functional floodplain habitat to increase the quantity and quality of rearing habitat for salmonids and sturgeon and spawning habitat for Sacramento splittail, and generate food resources for pelagic species.
- Providing adequate water quality and quantity within the Delta at appropriate times to help conserve resident native fishes and improve rearing and migration habitats for salmon moving through the Delta.

- **Other Conservation Actions** - The Steering Committee agreed to evaluate and, as appropriate, include in the BDCP other conservation actions designed to help address a number of stressors on covered species other than water conveyance facilities and operations. These stressors included: exposure to contaminants; non-native species; competition and predation; entrainment at non-CVP/SWP intake facilities; harvest; reduced genetic diversity and integrity; and effects of climate change.
- **Conveyance Facilities** - The Steering Committee agreed that the most promising approach for achieving the BDCP conservation and water supply goals involves a conveyance system with new points of diversion, the ultimate acceptability of which would turn on design, operational and institutional arrangements that the Steering Committee would develop and evaluate through the planning process. The main new physical feature of this conveyance system included the construction and operation of a new point (or points) of diversion in the north Delta on the Sacramento River and an isolated conveyance facility around the Delta. Further evaluations would also be conducted regarding potential modifications to existing south Delta facilities to reduce entrainment and otherwise improve SWP and CVP ability to convey water through the Delta while contributing to near and long-term conservation and water supply goals. This approach could provide enhanced operational flexibility and greater opportunities for habitat improvements and fishery protection. During the BDCP process, the Steering Committee evaluated the ability of a full range of design and operational scenarios to achieve BDCP conservation and planning objectives over the near and long term, from full reliance on the new facilities to use of the new facilities in conjunction with existing facilities.
- **Water Operations and Management** - The Steering Committee would develop and evaluate operating criteria for water conveyance facilities to achieve applicable near and long-term conservation and water supply goals.

D.4 IDENTIFICATION OF CORE ELEMENTS OF THE CONSERVATION STRATEGY

In January 2009, the Steering Committee identified the "core elements" to be carried forward in the conservation strategy for the BDCP. These core elements are set out in the document, *An Overview of the Draft Conservation Strategy for the Bay Delta Conservation Plan*, January 12, 2009 ("Overview Document"). The Overview Document provided an overview and synopsis of a draft conservation strategy, including its key components. The Steering Committee directed

that progress continue on the development of the BDCP and that certain issues be identified for further analyses. The Overview built upon concepts set out in the BDCP Planning Agreement and the 2007 BDCP *Points of Agreement for Continuing the Planning Process*. The Steering Committee confirmed a number of the "core elements" of the draft conservation strategy at that point in BDCP development and identified the remaining work necessary to complete a proposed conservation strategy. The core elements were selected for following attributes:

1. Elements that shape the overall architecture of the new hydrodynamic system that will be developed as a result of the BDCP.
2. Measures thatappear likely to be included in any scenario to rehabilitate the Delta ecosystem and water supply system.
3. Elements that can and should be planned or constructed in the next five to ten years.

The core elements formed the nucleus of the conservation strategy, but other conservation measures would also be necessary to achieve the BDCP planning goals and biological goals and objectives. The following are the core elements identified in the Overview Document:

1. Modify the Fremont Weir and Yolo Bypass to provide higher frequency and duration of inundation
2. Move primary diversion point to north Delta diversion facilities with fish screens to reduce entrainment and expand opportunities to achieve planning goals and conservation objectives
3. Hood bypass flow criteria
4. Manage south Delta exports/hydrodynamics to reduce entrainment of fish and food resources
5. Delta Cross Channel (DCC) operations
6. Large scale tidal marsh restoration in the Cache Slough area
7. Strategic tidal marsh restoration in the west Delta
8. Large scale tidal marsh restoration in the Suisun Marsh area
9. Interim tidal gates
10. Delta outflow targets
11. Continuing identification, development, and refinement of measures to address other stressors on covered fish species and natural communities

Figure D-15 depicts the core elements graphically within the BDCP Plan Area.

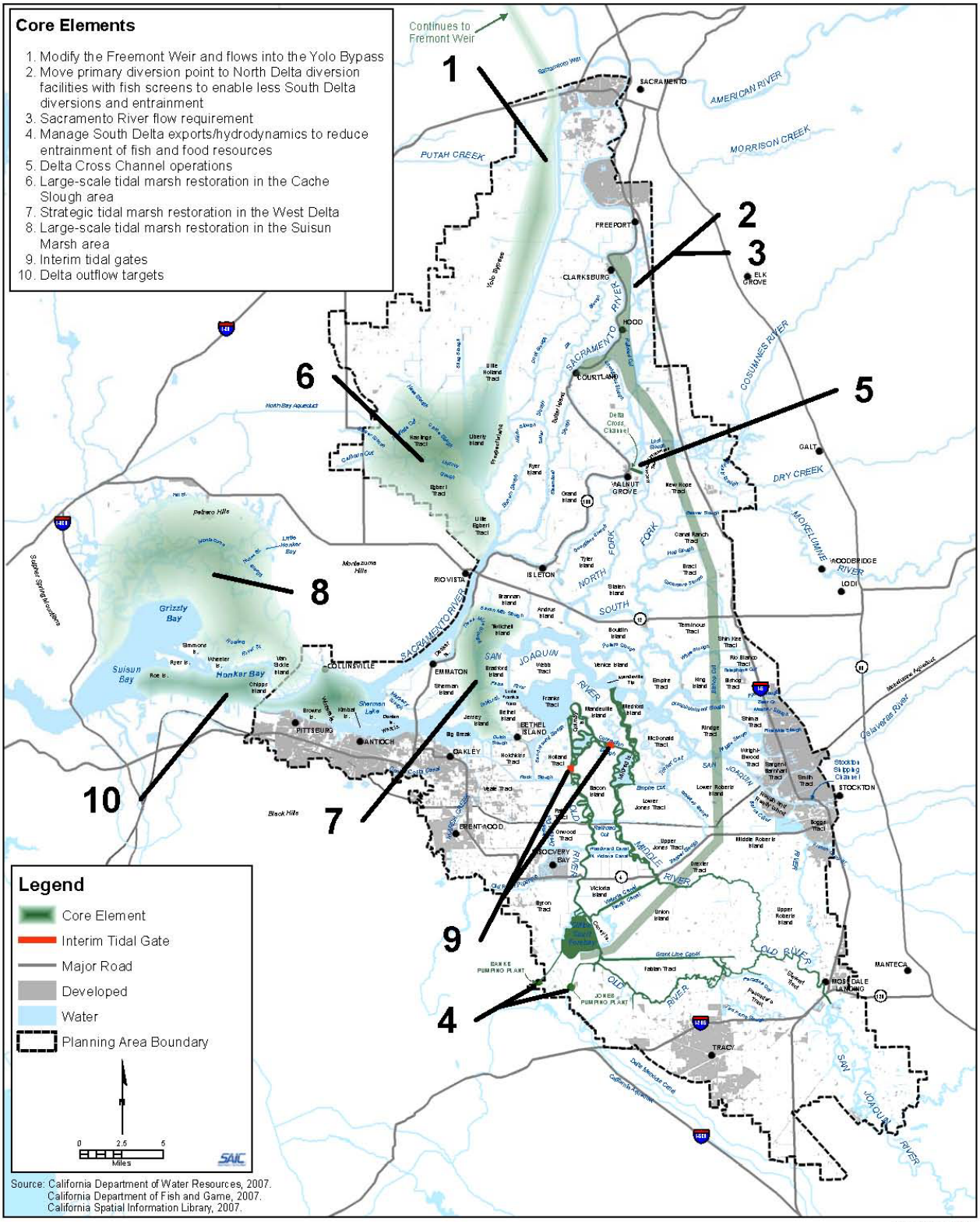


Figure D-15. Core Elements of the BDCP Conservation Strategy

1

D.5 DRERIP EVALUATION AND WORKING DRAFT CONSERVATION STRATEGY

From January to May 2009, the core elements of the conservation strategy were rigorously evaluated through a detailed analysis using operations and hydrodynamic models (e.g., CALSIM II and DSM2) and the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) ecological conceptual modeling tool. The DRERIP evaluation results, coupled with a follow-up synthesis evaluation, were used to refine the conservation measures. In July 2009, a working draft of BDCP Chapter 3 *Conservation Strategy* was prepared by the consultant team, reviewed by the Steering Committee, and posted on the BDCP Website. This working conservation strategy contained a full suite of conservation measures addressing the aquatic ecosystem, natural communities, and species. The process to develop conservation measures to address covered wildlife and plant species supported by terrestrial and wetland natural communities was initiated in summer 2009.

D.6 DEVELOPMENT OF CONSERVATION MEASURES

This section further describes the process and evaluations used to develop the conservation measures included in the Conservation Strategy.

D.6.1 Water Operations Conservation Measures

D.6.1.1 Conveyance Facilities Configuration

The Steering Committee evaluated the practicability of three isolated conveyance facility configurations that would provide for dual-conveyance operations: 1) a west Delta conveyance configuration consisting of a combination of surface canal and pipeline/tunnel conveyance facilities, 2) an east Delta conveyance configuration consisting of a surface canal conveyance facility, and 3) a pipeline/tunnel conveyance facility (see Figure D-16). Practicability criteria included:

- Extent of land removed to construct each configuration as a measure of potential impact on existing land uses and infrastructure;
- Construction schedule;
- Preliminary estimates of conveyance facility construction and land costs;
- Preliminary estimates of conveyance facility operations and maintenance costs;
- Construction risks and concerns;
- Preliminary estimates of environmental impacts; and
- Preliminary estimates of mitigation land costs.

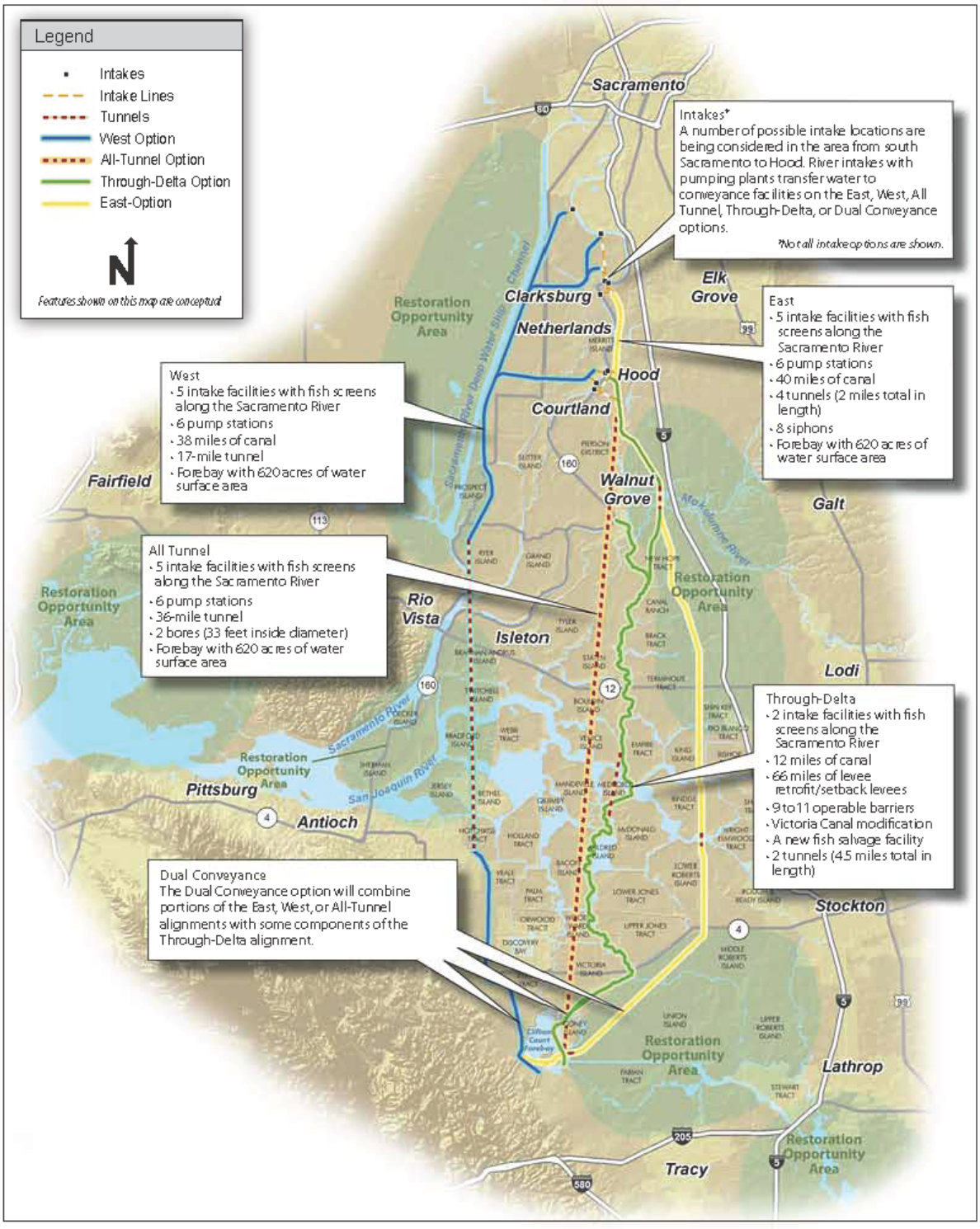


Figure D-16. Evaluated Conveyance Configurations

Based on results of the evaluation, the Steering Committee selected the pipeline/tunnel configuration. Although the preliminary estimated costs for the pipeline/tunnel configuration were greater than for the west Delta and east Delta conveyance configuration, the Steering Committee selected this configuration because it minimized impacts on natural communities supporting habitat the covered species and minimized impacts on the human environment.

D.6.1.1.1 North Delta Diversion Facilities Location and Screening

North Delta Diversion Facilities Location

Evaluations were conducted on a broad variety of north Delta diversion intake location configurations. Possible intake locations were analyzed in terms of the availability of water for the diversion, the ability to divert at each intake location, potential impacts to other diverters and dischargers, fish exposure to intakes, fish migration corridors, potential water quality, and costs involved in construction and operation. This high level, preliminary analysis provided information sufficient to focus in on potential intake locations.

A detailed analysis of four intake configurations was conducted in 2010. Configuration #1, which is the proposed project, has five intake locations placed on the Sacramento River between Freeport and Courtland. Configurations #2-4 would have intakes 1-3 in the same location as in Configuration #1 (from Freeport to Hood), but the location of intakes 4 and 5 would vary. In Configuration #2, intakes 4 and 5 would be located upstream of the American River point of confluence with the Sacramento River, north of intakes 1-3. In Configuration #3, intakes 4 and 5 would be located downstream of the American River point of confluence with the Sacramento River and upstream of the Freeport Regional Water Authority intake and Sacramento Regional County Sanitation District outfall, also north of intakes 1-3. In Configuration #4, intakes 4 and 5 would be located south of intakes 1-3, downstream of Steamboat Slough and upstream of the Delta Cross Channel.

Diversion capability appeared to be insensitive to the intake configurations considered in the detailed analysis. Operations and operational preference were shown to be more important than intake location for effects on tidal dynamics. The analysis also showed that intake locations primarily influence exposure risk, and to a lesser extent, migration pathways.

Screening of Diversion Facilities

In August, 2008, the Fish Facilities Technical Team (FFTT) developed a preliminary draft report (*Fish Facilities Technical Team Conceptual Screening Proposal*) with the purpose of reviewing and evaluating various approaches to the screening of diversion facilities along the Sacramento River between the City of Sacramento and Walnut Grove. The screen design principles used in this analysis incorporated guidance and criteria offered by NMFS, DFG, and FWS. These principles included using designs that would:

- Focus on being the most biologically protective;

- Provide a positive, physical barrier between fish and water intakes;
- Avoid the need to collect, concentrate, and handle fish passing the intake;
- Avoid bypasses that concentrate fish in areas and increase the risk of predation;
- Steer clear of "off-channel" systems in order to avoid handling fish;
- Select locations that have desirable hydraulic characteristics (e.g., uniform sweeping velocities, reduced turbulence);
- Use the best available existing technology in use in the Sacramento Valley;
- Use smaller multiple intakes (as opposed to a single large intake) to enhance fish protection with operational flexibility under varying flow conditions;
- Minimize the length of intake(s) to reduce the duration of exposure to the screen surface for fish;
- Select locations on the Sacramento River as far north as practicable to reduce the exposure of delta smelt, longfin smelt, and other estuarine species;
- Avoid areas where predators may congregate or where potential prey would have increased vulnerability to predation; and
- Avoid areas of existing riparian habitat.

The FFTT developed, analyzed, and provided recommendations on fish screen criteria, including design approach velocities; fish screen type; size and number (multiple versus a single intake); and locations(s) that would support both through and around the Delta conveyance facilities. The following three primary fish screening technologies were examined in the report: on-bank screens, in-river screens, and cylindrical screens.

On-bank screens would be similar to the many flat plate wedge wire screens operating on the Sacramento River. The length would be designed to match any accompanying in-river screens at specific locations. In-river screens would be a long intake tower with dual screen surfaces similar to the City of Sacramento's water intake on the Sacramento River and the American River. The major difference is that the pumps would not be situated on the tower but on the landside of the levee. Water would flow through the screens on the tower, then into pipes buried in the river bottom and under the levee, then into a wet well system where the water would be pumped into a collection channel. Cylindrical screens would be similar to the many cylindrical screens operating on the Sacramento River such as at Reclamation District 999 in the Delta. Several units would be combined in a cluster to provide the diversion capacity needed for each location. The overall concept is that screens would be combined in a modular fashion at a single location to provide optimum protection for fish. Four conceptual proposals came out of the *Fish Facilities Technical Team Conceptual Screening Proposal.*

Conceptual Proposal A

Concept A consisted of a combination of in-river and on-bank screens situated at three locations on the Sacramento River between Freeport and Courtland. Each location would provide a diversion capacity of 5,000 cfs for a combined maximum diversion of 15,000 cfs. To minimize exposure to the screen surface both in-river and on-bank screens the screen surface is limited to approximately 300 feet in length. The in-river screens would have a screen surface on both sides of the supporting structure allowing for a total screened flow of 2,500 cfs, while the on-bank screen would be limited to 1,000 cfs.

Conceptual Proposal B

Concept B consisted of using cylindrical screens at ten locations along the Sacramento River between the City of Sacramento and Walnut Grove. Each location would have a diversion capacity of 1,500 cfs using a cluster of cylindrical screens. An estimated capacity of 100 cfs for each screen would require a cluster of fifteen units to provide the desired diversion capacity at each site. Ten locations with a 1,500 cfs diversion capacity would be necessary to achieve a combined maximum diversion of 15,000 cfs.

Conceptual Proposal C

Concept C consisted of on-bank and in-river screens situated at ten locations on the Sacramento River between the City of Sacramento and Walnut Grove. Each location would provide 1,500 cfs of diversion capability for a combined maximum of 15,000 cfs.

Conceptual Proposal D

Concept D consisted of a combination of on-bank cylindrical screens and in-river dual face screens situated at ten locations on the Sacramento River between the City of Sacramento and Walnut Grove. Each location would provide 1,500 cfs diversion capacity for a maximum combined diversion of 15,000 cfs.

An additional study, the Value Planning Study on Fish Screening Facilities options, was conducted by the DWR Delta Habitat Conservation & Conveyance Program (DHCCP). Contributing materials included the *Fish Facilities Technical Team Conceptual Screening Proposal* preliminary draft report, potential northernmost alignments for both a western and eastern scenario of an isolated canal, and a five-day value methodology workshop with a multidisciplinary team in Sacramento, California, held in October, 2008. The Value Planning Study identified and scored 31 different concepts for intakes on the Sacramento River that would have the capability to divert up to 15,000 cfs. The three types of intakes were on-bank, in-river, and cylindrical. The capacity of intakes ranged from 500 to 5,000 cfs.

Each of these concepts was rated based on performance criteria, one of which was fish protection/fish benefits. However, as identified in the report, for the ratings to be relevant, the analysis needed to be extended to associate a level of importance to the performance factors.

Based on all of the analyses described above, the configuration ultimately selected included five intakes of 3,000 cfs each located between Freeport and Hood utilizing in-river intakes. However, after the effects analysis was completed, on-bank screens were selected.

D.6.1.1.2 Operational Criteria

This section provides an overview of the development of the BDCP operation criteria including the involvement of various workgroups and teams in this process.

Development of BDCP Long-Term and Near-Term Water Operations

The development of draft BDCP Proposed Project water operations for Long-Term and Near-Term was performed through an iterative and multi-step process involving substantial input from science and stakeholders. As described above, the conservation strategy options evaluation of four distinct conveyance scenarios (Existing Through-Delta Conveyance, Improved Through-Delta Conveyance, Dual Conveyance and Peripheral Aqueduct) was finalized in September 2007 and resulted in a focus on Dual Conveyance. Long-Term and Near-Term water operations and integration of operations with habitat and biological criteria were explored throughout 2008 and 2009, resulting in Steering Committee approval of draft Long-Term operations criteria on January 29, 2010. The exploration and evaluation process for water operations is summarized below in chronological order.

Conveyance Workgroup (CWG) and Habitat and Operations Technical Team (HOTT)

In October 2007, the Conveyance Workgroup (CWG) and the Habitat and Operations Technical Team (HOTT) were formed to evaluate a range of Delta water operations and integration of those operations with various habitat restoration elements. Screening-level evaluations were prepared based on geographically-focused packages including North, West, and South Delta. Working groups and technical teams met periodically to develop technical information or recommendations about aspects of the Conservation Plan elements for consideration by the Steering Committee. The CWG and HOTT conducted many meetings with input from technical experts.

The following geographically-focused packages and critical issues were evaluated:

North Delta Bypasses and Diversion Criteria

- Yolo Bypass and hydraulic characteristics of current Fremont Weir;

- Hydraulic characteristics of potential changes to Fremont Weir, a proposed, Deep Water Ship Channel bypass, and proposed Stone Lakes bypass;
- Connectivity of Sacramento River with Sutter and Steamboat Sloughs;
- Relationship between changes in Sacramento River flow and flow in Sutter Slough, Steamboat Slough, Delta Cross Channel, and Georgiana Slough;
- North Delta diversion bypass considerations including river bypass flows, effects on Delta Cross Channel and Threemile Slough flows, and Rio Vista flows; and
- Preliminary analysis of north Delta diversions based on fish screen sweeping velocity criteria.

West Delta and Outflow Operations

- Delta outflow needs and targets for region of low salinity zone;
- Effect of Sherman Island and other West Delta tidal habitat;
- Montezuma Slough salinity control gate re-operation; and
- Suisun Marsh tidal habitat and restoration.

South Delta Operations

- Evaluation of changes to hydrodynamics and water quality due to proposed tidal marsh habitat;
- Water quality and particle transport and fate effects;
- San Joaquin River at Vernalis salinity sensitivity to different summer-fall Vernalis's flow increments;
- Analysis of two alternative spring X2 operating assumptions[5]: (1) operations where salinity is maintained roughly to D1641 but implemented as a function of Eight River Index and over the 5-month period Feb-Jun, and (2) a proposal by the NGO community where outflow is increased in many years and implemented as a function of the Eight River Index; and
- Operational and entrainment effects of South Delta Gates and isolated Old River corridor.

Many of the broad options considered under the geographically-focused packages were integrated in delta-wide assessments. Preliminary analyses utilized the CalLite screening model to better understand the integrated relationship between north delta, south delta, and delta outflow criteria. Assumptions were made for north delta floodplain habitat and tidal marsh,

[5] X2 is defined as the distance (in km) from the Golden Gate Bridge at which bottom salinity is 2 parts per thousand.

Sacramento River diversion and downstream bypasses, delta salinity standards, west delta habitat, tidal marsh, and delta outflow. Implementation of various bypasses, north delta diversion criteria, south delta criteria, and outflow criteria were included in the CalLite modeling and the strong interrelationship between elements was reviewed.

Focused hydrologic and hydrodynamic modeling was used as a tool to assist in the evaluation of some of the complex items listed above. Preliminary HEC-RAS modeling was performed to evaluate the effects and capability of proposed modifications to Fremont Weir and proposed Deep Water Ship bypass weir. These bypasses were evaluated to estimate the extent and frequency of activation of proposed floodplain habitat. Preliminary, coarse-level CALSIM II and DSM2 simulations were prepared to evaluate specific delta-wide scenarios and the hydrologic and system response over a wide range of hydrologic conditions. CALSIM II was simulated on a monthly time step for 82 years to provide output for parameters such as river flows, exports, water supply impacts, reservoir storage conditions, and system controls. DSM2 simulation was used to evaluate the hydrodynamic, water quality, and particle transport and fate conditions. Limitations in the modeling tools related to tidal marsh effects and time step were noted and plans were developed for enhancement of the tools. A re-calibration of DSM2 was initiated at this time to include important effects of Liberty Island flooding on north delta hydrodynamics.

Integration Team and Conveyance Workgroup (CWG)

From October 2008 through January 2009, the work products and findings of several workgroups were incorporated in evaluations by the Integration Team.

By the end of 2008, two interactive screening evaluations were conducted using the CalLite screening model; one in October and one in December. Various scenarios were analyzed to help explore concepts of interest by the stakeholders and were developed to assist in the formation of proposed conservation measurements. The scenarios developed and preliminary lessons learned are described below.

Fluctuating Delta Salinity. Relaxations in the net delta outflow requirements were investigated during summer and fall (4000 cfs in a wet year, 3000 cfs in an above normal year, 2000 cfs in a below normal year, 1000 cfs in a dry year, and 0 cfs in a critical dry year) to explore a range of salinity and X2 effects. Rio Vista, salinity, and EI ratio standards were also relaxed during this period. The goal was to evaluate the range of variable salinity (increasing salinity in summer and fall of dry years) to could be achieved and believed to provide a competitive advantage to native species. The preliminary lessons learned from these analyses were:

- Higher fall and/or summer salinity can be managed with a rather rapid return to fresher western Delta conditions in early winter as long as salinity intrusion in the south delta was not substantial;

- South delta water quality could be severely degraded during these times without mitigating actions such as increased San Joaquin flows or canal turnouts, but rate of recovery is unknown without DSM2 modeling;
- Upstream storage is significantly enhanced and coldwater pools would be improved, but river flows would be reduced; re-imposition of Rio Vista requirements would help mitigate these reductions;
- Variable salinity (increasing salinity in summer and fall of dry years) provides a competitive advantage to native species;
- Exports are improved under a variable salinity assumption, particularly with the summer salinity encroachment;
- Under variable salinity scenarios, adding back Rio Vista flow criteria did not have a significant impact on the remainder of the system or delta conditions; and
- There is insufficient information on desired salinity regimes and biological implications for key species.

Flooded Western Island. Based on Delta Risk Management Study (DRMS) analyses, scenarios of salinity shifts related to Sherman Island flooding were conducted. The DRMS work suggested that such a flooding event could result in an eastward shift in X2 of approximately 6 km. The CalLite model was reconfigured to account for this effect. The simulation goal was to evaluate if flooding of large tracts of western islands may create large areas of low salinity habitat and allow X2 to be managed more easterly than under current regime. The preliminary lessons learned were:

- Significant intrusion expected with Sherman flooding. X2 expected to move eastward by almost 6 km for the same outflow.
- Under the same X2 compliance conditions (D1641), Delta outflow requirements would cause significant loss of water supply and largely eliminate ability for coldwater pool management in reservoirs. Change of X2 compliance is virtually a necessity under these conditions.
- Movement of X2 compliance eastward suggests that water costs would be similar to that under current conditions – no net gain or loss of water supply due to compliance change. However, the CalLite modeling could not simulate complex salinity intrusion dynamics such that results have considerable uncertainty.
- DSM2 and RMA modeling would be necessary to better understand the hydrodynamic and salinity effects.

Preferential Hood Diversion without D-1641. All D-1641 standards were removed from a basic dual-conveyance simulation. This scenario was an educational study to evaluate system

operations effects and evaluate incremental tradeoffs of regulatory actions. The preliminary lessons learned were:

- Achievement of broad desired Delta conditions could be achieved by adding three major controls to the Delta: Hood bypass rules, Delta outflow requirements, and south delta Old and Middle River (OMR) criteria.
- Adding Hood bypass rules without outflow or OMR, primarily resulted in changes to the point of diversion, not substantial changes in total exports.
- Results suggest a range of salinity that is somewhat comparable to the variable salinity scenario and potential synergies were observed between the two.

Increased Spring River Flows. Reservoir releases to target peak flows in March and April to achieve Yolo bypass inundation of approximately 5,000 cfs. The goal of the scenario was to evaluate Delta operations with increased inflows designed to substantially restore spring hydrographs on rivers and to increase frequency and duration of inundation of bypasses. The preliminary lessons learned were:

- Daily analysis is more suitable for capturing dynamics of flood hydrographs and spills, but monthly analysis indicates little change in frequency of inundation with additional releases;
- Releases increased the extent of flooding with higher flows as well as re-shaped the hydrograph all the way to Rio Vista;
- Water costs of reservoir release actions are considerable, despite timing with natural hydrology. Potentially as high as 250-300 TAF annually without consideration of San Joaquin River flow augmentation;
- Increased San Joaquin River flows generally had a positive effect on spring time QWEST and OMR flows, potentially decreasing entrainment effects and improving water quality;
- The Fremont Weir with the proposed modification is inefficient from the standpoint of reservoir releases in that approximately 20,000 cfs is required in the river to achieve 5,000 cfs over the weir; and
- Months of flow targets could be varied to achieve substantial biological benefits while eliminating large water cost. December-January period could be beneficial for winter run salmon.

Increased Spring Delta Outflow. The 8-River Index (8RI)[6] approach to February through June average X2 targeting was implemented along with minor off-ramps for extreme critical years

[6] The 8 River Index is the combined Sacramento River and San Joaquin River basin runoff. Sacramento River runoff is calculated as the sum (in maf) of Sacramento River at Bend Bridge, Feather River inflow to Lake Oroville, Yuba River at Smartville, and American River inflow to Folsom Lake. San Joaquin River runoff is calculated as the sum (in maf) of Stanislaus River inflow to New Melones Lake, Tuolumne River inflow to New Don Pedro Reservoir, Merced River inflow to Lake McClure, and San Joaquin River inflow to Millerton Lake.

(8RI less than 5 MAF). The objective was to evaluate the potential for achieving substantially higher Delta outflow targets without creating adverse coldwater pool management concerns in key reservoirs. The preliminary lessons learned were:

- More westerly spring X2 could be achieved but would require reductions in Sacramento Valley deliveries and/or Delta exports;
- High Delta outflow requirements in the spring generate a trade-off between upstream and downstream benefits due to the impact on reservoir storage;
- Conflicts are highest during dry periods, but some system recovery occurs during wetter periods;
- Provision of off-ramps based on upstream storage conditions reduced the impact, but failed to protect declining storage during extended drought periods; and
- Operations need to be significantly refined to make these scenarios more reasonable, but will likely result in greater water cost.

Increased Fall Delta Outflow. Fall X2 targets (September-November) were explored based on a water year 8RI index approach originally proposed by the NGOs. Storage criteria were included to limit the potential for upstream impacts (Shasta > 2.8 MAF and Oroville > 1.0 MAF). The goal was to evaluate potential for achieving higher fall Delta outflow targets without creating adverse coldwater pool management conditions in key reservoirs. Initial assessments indicated that the Fall X2 targets, as constructed as a sliding scale based on the prior water year 8RI, appeared achievable with relatively low water costs.

Preferred South Delta Diversion. South Delta pumping would continue at a reduced amount with limited entrainment effects while reducing the need for higher diversion at Hood. The preliminary lessons learned were:

- Dual conveyance operations preferring the south Delta diversions could be configured with export supplies similar to Existing conditions, but would continue reliance on a through-Delta flow pathway;
- Reducing flow conditions that may lead to entrainment could be accomplished through Old and Middle River requirements (in other scenarios) or limiting exports as a function of San Joaquin River flows (this scenario); and
- Greater flexibility in opening of DCC gates after August helps protect against central/south Delta water quality degradation and could benefit exports under a south Delta preferred point of diversion.

Fully Isolated Hood Diversion. A set of scenarios was explored to evaluate the potential of a fully isolated north Delta diversion (no south delta pumping) subject to more restrictive Hood

bypass flow operations. These no south Delta pumping scenarios would open much of the central and southern Delta for restoration. The preliminary lessons learned were:

- Project operations under a fully isolated Hood diversion WITH high bypass rules need further review as some primary delivery needs would not be satisfied in dry years – modeling needs to be refined;
- May be necessary to require upstream inflows to achieve a more natural hydrograph; restricting Hood diversions by itself does not produce the hydrograph;
- Fully isolated would make increased spills into Yolo Bypass more costly as the supplies could not be recovered for export;
- Need to refine allocations logic in CalLite to better estimate water cost of this scenario. An expected outcome is considerably lower allocations (deliveries) and improved reservoir storage conditions;
- Limitations on total exports are often controlled by the Hood Bypass requirements and Rio Vista flow requirements; and
- Need to be aware that fully isolated scenario may not meet water supply objectives. Also need to make the isolated facility strong enough to withstand failure.

In addition to the screening analyses discussed above, a set of technical studies were outlined to assist in the development of an overall water operations package: (1) North Delta Diversion Effects, (2) North Delta Migration Corridors, (3) South Delta Diversion Effects, and (4) Tidal Marsh Restoration Effects. Preliminary work was performed for the technical studies, but these studies were continued throughout subsequent phases of Long-Term water operations development.

Core Elements Preliminary Evaluation - Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) Assessment

By the end of year 2008 the BDCP Steering Committee approved a draft set of Core Elements of a Conservation Strategy for preliminary evaluation. The preliminary evaluation was principally designed to provide information for the conceptual ecosystem and species evaluation process known as the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The goal of this evaluation was to refine existing and develop new Delta specific restoration actions as well as to provide Delta specific implementation guidance, program tracking, performance evaluation and adaptive management feedback. Preliminary CALSIM II and DSM2 modeling was performed based on a range of parameters to better understand the changes to Delta flows and patterns of exports, Delta hydrodynamic responses due to modified diversions and tidal marsh restoration, travel time in the north delta downstream of the diversion, and general changes to Delta water quality.

The Core Elements consist of the following changes to the Delta system configuration and operations:

1. Modification of the Freemont Weir and Yolo Bypass to provide more frequent and greater duration of inundation; up to 4,000 cfs during December 1 through May 15.

2. Move primary point of diversion to a new north Delta diversion facilities with state-of-the-art fish screens; up to 15,000 cfs capacity subject to bypass criteria, river flows, downstream requirements, and conveyance limitations.

3. Establishment of bypass flows (two scenarios) at north Delta diversion that limit diversions during lower flows and during periods of concern for covered species; 11,000 cfs and 5,000 cfs bypass flow scenarios in winter-spring.

4. Manage south Delta exports to reduce entrainment of fish and food resources; Old and Middle River flow greater than -3,500 cfs (December through June) and greater than -5000 cfs (July through November).

5. Closure of the Delta Cross Channel except during July, August, and half of September and October for south/central Delta water quality protection.

6. Large-scale tidal marsh restoration in the Cache Slough area; 5,000 – 15,000 acres.

7. Strategic tidal marsh restoration in the west Delta.

8. Large-scale tidal marsh restoration in the Suisun Marsh area.

Three modeling studies were developed for the purposes of this initial evaluation. A "Reference" study was developed to provide a representation of conditions under existing facilities and D-1641/CVPIA (b)(2) operations. "Scenario 1" study represents the changes indicated in Core Elements 1 through 6 with the higher bypass flow criteria for north Delta diversions. "Scenario 2" represents the changes indicated in Core Elements 1 through 6 with the lower bypass flow criteria for north Delta diversions. A more detailed description of the Core Elements is provided in the "Overview of the Draft Conservation Strategy for the Bay Delta Conservation Plan" revised January 12, 2009. All studies were developed at 2030 level of development and demands to better reflect the future condition associated with these BDCP elements.

Integration Team and Leaders/Caucus Team Proposed Project Development

Based on the results of the analysis of the Core Elements, key areas of uncertainty were identified as well as needed improvements to modeling. During February 2009 through December 2009, additional analyses and refinements were made to the water operations. These studies and/modifications included the following work items:

Climate Change "Early-Look." In order to include changes in runoff and increased sea level rise due to climate change in the current modeling, regional climate change scenarios were developed based on the climate scenarios used by the DWR. A preliminary set of CALSIM II and DSM2 model simulations were performed to understand the effect of climate change on the existing system configuration and dual conveyance operations. Climate change was shown to have a significant effect on the timing of watershed runoff, earlier runoff due to more rain/less snow and earlier snowmelt, and significant reductions in late spring and summer streamflows. Upstream reservoir and coldwater pool management were found to be severely challenged under climate futures, while the delta/export facilities were found to become more de-coupled from the SWP/CVP storage operations. Salinity and X2 were shown to intrude further, but that higher outflows could manage the extent of the intrusion. The BDCP Proposed Project was found to include several elements that provide some climate change adaptation. These include tidal marsh, floodplain inundation, and movement of the primary conveyance out of the major tidal zone in the delta.

North Delta Bypass Flows and Operations. Various preliminary simulations were conducted to evaluate the location of intakes for north Delta diversion facilities. Also, operational rules for north Delta diversion facilities were developed to refine tidal operations under low flows.

Tidal Marsh Implementation in DSM2. Corroborative simulations with the 2-D RMA model were conducted to better "calibrate" this component of DSM2. Inclusion of Suisun Marsh restoration components was subsequently incorporated. In addition, re-training of CALSIM II's Artificial Neural Network (ANN) to emulate the effects of tidal marsh restoration was performed.

DSM2 Re-Calibration. Limitations associated with the DSM2 model were identified and a re-calibration of the model was performed to include a more accurate representation of the Cache Slough region and Liberty Island flooding.

Daily Operations. Other modeling improvements to better represent the Delta operations scenarios included the CALSIM II incorporation of daily operations in the Fremont weir operations and North Delta diversion for deriving a more accurate input to DSM2.

Delta Island Consumptive. The Delta island consumptive use and drainage utilized in both DSM2 and CALSIM II models were reviewed to better represent the local behavior.

Mini-Effects Analysis

In late 2009 and early 2010, a "mini- effects analysis" of a preliminary Proposed Project under Near-Term and Early Long-Term (Proposed Operations and two adaptive Ranges, A & B) scenarios was performed. The objective of this analysis was to prepare a final set of conservation measures for the final physical modeling of the Proposed Project. The preliminary modeling results were presented in comparison to the Pre-BiOps and RPA condition scenarios. The results included:

- CALSIM II for the hydrology and System Operations 82-year monthly flows;
- DSM2-HYDRO for hydrodynamic 15-MIN flow and velocity;
- DSM2-QUAL for Electric Conductivity averaged from daily values to the appropriate multi-day averaging period for the standard;
- DSM2-PTM for 21-day and 120-day fate mapping, residence time mapping, flow conditions for each PTM insertion period, summary results requested by Estuarine fish sub-group;
- DSM2 Source Water Finger Printing monthly values; and
- Sacramento River Water Quality Model (SRWQM), daily temperature.

In addition to these simulations, CALSIM sensitivity analyses were performed to identify relative effects of various actions:

1. RPA sensitivity. Action comparisons versus the RPA "most likely" simulation.
    a. Removal of NMFS BO San Joaquin Inflow-Export ratio (Action IV.2.1)
    b. FWS OMR Action 2 and 3 "low" bookend
    c. FWS OMR Action 2 and 3 "high" bookend
    d. Removal of FWS fall X2 Action 4
2. Alternative D-1641 X2 approach. Comparison versus the Proposed Project near-term simulation. Near-term operations with existing D-1641 X2 implementation.
3. Proposed Project action sensitivity. Action comparison versus the early long-term Prop Ops simulation.
    a. Hood bypass flows per Range B
    b. San Joaquin Export-Inflow ratio during Oct-Jun per Range B
    c. Spring X2 based on 8 River Index per Range B, Fall X2 per FWS RPA

Draft Proposed Project Long-Term Water Operations

The results of the mini effects analysis combined with various biological and policy-level discussions in December 2009 and January 2010 led to the a draft set of Long-Term water operations criteria for evaluation in the Effects Analysis. On January 29th, 2010 the Steering Committee approved the Late-Term water operations and a Full Effects Analysis was initiated. *[Note to reviewers: This will be updated going forward.]*

D.6.2 Physical Habitat Restoration

The Conservation Strategy includes physical habitat conservation measures to benefit the aquatic resources (i.e., the covered fish species, the tidally influenced perennial aquatic natural communities, and aquatic ecosystem processes) and terrestrial resources (i.e., the covered wildlife and plant species the non-tidal natural communities) addressed by the Plan. Development of the physical habitat conservation measures initially focused on addressing the conservation needs of the aquatic resources. The draft conservation measures for aquatic resources were then refined to incorporate elements that would achieve the biological objectives for covered wildlife and plant species that used tidal habitats and additional measures were developed to address those covered wildlife and plant species that use non-tidal habitats for all or a portion of their life histories.

D.6.2.1 Development of Physical Habitat Conservation Measures for Aquatic Resources

In January 2008, the Steering Committee established the Habitat Restoration Program Technical Team (HRPTT) to develop physical habitat-related conservation measures (as opposed to flow-related habitat conditions). HRPTT was comprised of technical experts representing the PREs, NGOs, and Fishery Agencies. Development of conservation measures was supplemented with outside technical experts to advise the HRPTT on technical issues as needed.

D.6.2.2 Process for Identifying Potential Habitat Conservation Actions

The process used by the HRPTT to develop the habitat restoration and enhancement measures is described below.

D.6.2.2.1 Species Stressors

At the start of the process, the HRPTT reviewed the available scientific literature, including information developed by the Fishery Agencies, to identify important stressors on the covered fish species that are manifested in the Delta. These stressors were evaluated using existing scientific information and previous evaluations (e.g., CALFED ERP) to determine if their adverse effects on the covered fish species could be alleviated through physical habitat restoration or enhancement actions.

D.6.2.2.2 Habitat Conservation Actions

Based on the assessment of covered fish species stressors manifested in the Delta, the HRPTT reviewed relevant literature (e.g., DRERIP models, CALFED ERP conservation actions, recovery plans) to identify physical habitat conservation actions that could affect the influence of stressors on each of the covered fish species. The HRPTT identified the four types of habitat conservation actions described below.

Tidal Habitat Restoration. An important hypothesized stressor on several of the covered fish species is food abundance and availability. Based on current hypotheses regarding the ecosystem functions of tidal marsh, the HRPTT identified restoration of tidal marsh habitat as a mechanism to increase primary and secondary production in adjacent subtidal aquatic habitats that would improve aquatic foodweb processes and thus increase the abundance of food for the covered fish species. A secondary outcome of tidal marsh restoration would also be restoration of shallow subtidal aquatic habitat area that would serve as rearing habitat for salmonids and splittail and, in some locations, potential spawning habitat for delta smelt.

Seasonally Inundated Floodplain. The HRPTT identified restoration of seasonally inundated floodplain as an opportunity to address stressors related to splittail spawning and rearing habitat, salmonid rearing habitat and risk of non-native fish predation, and food availability. Restoration of floodplain habitat by setting back levees would increase the extent of floodplain area within the Delta that would be inundated during periods of high flow, thus increasing the extent of splittail spawning and rearing habitat, salmonid rearing habitat, and production and subsequent transport of phytoplankton, zooplankton, and invertebrates into Delta channels that would increase food for covered fish species rearing on restored floodplains and in Delta channels.

Channel Margin Habitat. The HRPTT identified enhancement of low-value leveed channel margin habitats as an opportunity to address stressors related to the lack of juvenile salmonid rearing habitat, splittail spawning habitat, exposure to non-native fish predation, and food production and availability. Increasing the complexity of existing channel margin habitats was hypothesized to increase the survival of outmigrating juvenile salmonids by increasing rearing habitat and growth and, depending on design, increasing the extent of splittail spawning habitat.

Riparian Habitat. The HRPTT identified restoration of tidal riparian habitat as an opportunity to improve the overall ecological functions of the Delta. Restoration of riparian habitat would increase complexity of channel margin habitats and increase inputs of food and organic carbon (i.e., insect and leaf drop into channels) in support of aquatic foodweb processes.

D.6.2.3 Identification of Habitat Restoration and Enhancement Opportunities

Following identification of physical habitat restoration and enhancement actions that could alleviate the effects of covered fish species stressors, the HRPTT divided the Delta and Suisun Marsh into 11 hydrologic zones for purposes of spatially evaluating opportunities for restoring or enhancing each of the four habitat types (see Figure D-17). The HRPTT then compiled available information characterizing the physical and biological conditions in each of the zones to provide the basis from which to make subsequent evaluations of habitat restoration and enhancement opportunities. These zone attributes included, but were not limited:

- Land surface elevation relative to mean sea level elevation;
- Existing land uses, for agricultural lands, crop type (i.e., annual vs. perennial crops);
- Infrastructure;

- Areas of high habitat value for biological resources; and
- Location relative to the distribution of covered fish species.

Concurrently, the HRPTT also conducted reviews of existing habitat restoration plans for the Delta and Suisun Marsh (e.g., CALFED ERP) to identify restoration opportunities relevant to achieving BDCP goals and objectives.

D.6.2.3.1 Tidal Habitat Restoration

The HRPTT evaluated each of the hydrologic zones to identify practicable locations suitable for restoring tidal marshes. To guide this evaluation, the HRPTT established a goal of distributing tidal marsh restoration around the Plan Area such that all the covered fish species associated with each of the Delta watersheds would benefit. Major criteria used to identify these locations included:

- Land surface elevations relative to mean sea level;
- Land uses;
- Infrastructure; and
- Potential tidal connectivity.

Based on application of these criteria, the HRPTT delineated five Restoration Opportunity Areas (ROAs; see Figure 3-1) with site characteristics within which tidal marsh restoration could be practicably implemented.

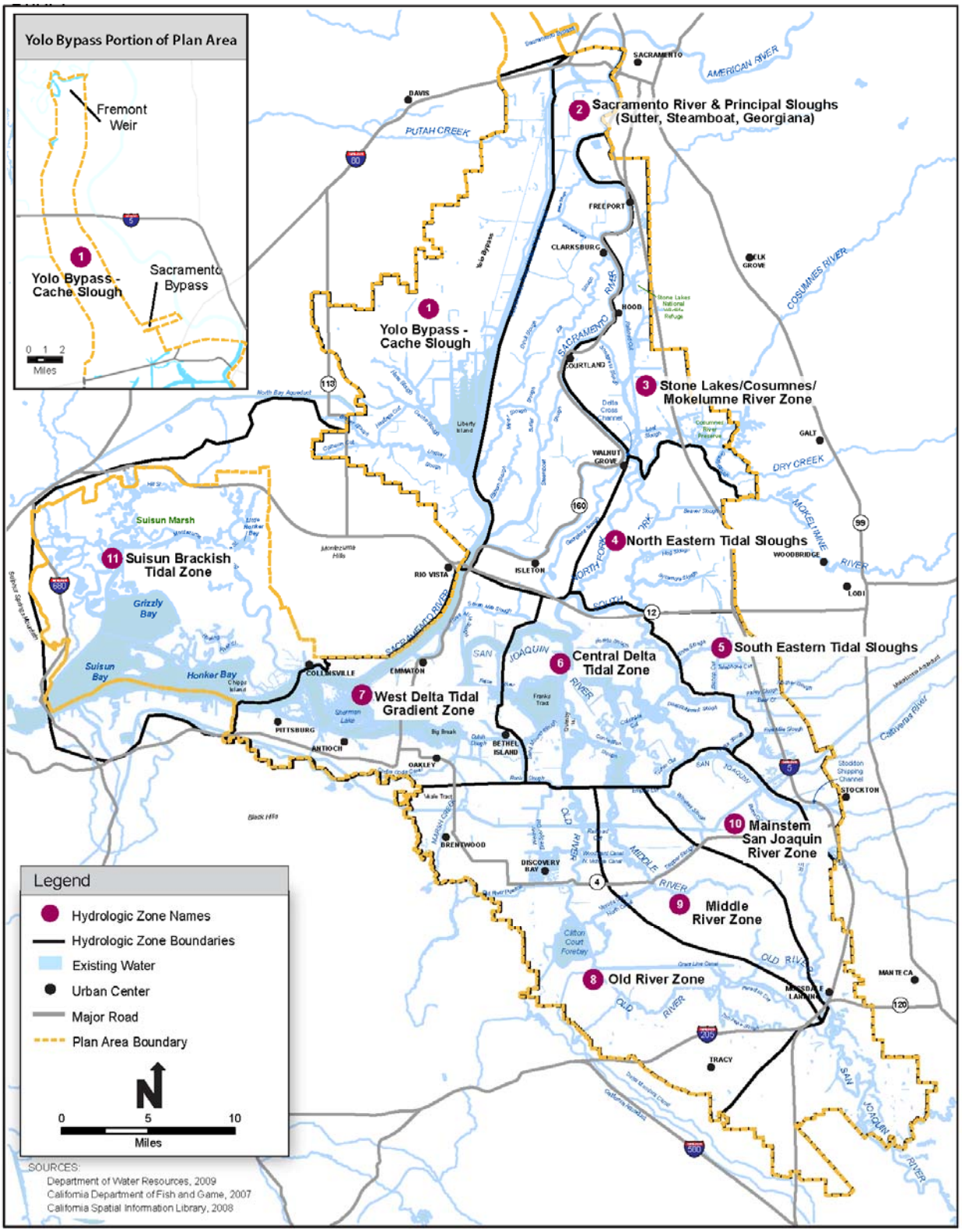


Figure D-17. BDCP Hydrologic Zones Used to Develop Physical Habitat Conservation Measures

Seasonally Inundated Floodplain Restoration

The HRPTT evaluated each of the hydrologic zones to identify practicable locations suitable for restoring seasonally inundated floodplain. Major criteria used to identify these locations included:

- Land surface elevations relative to mean sea level;
- Opportunities to coincidentally improve capacity of the flood control system;
- Existing ecological values of potentially affected habitats;
- Land uses; and
- Opportunities to recreate historical connectivity of floodplains with tidal marshes.

Based on application of these criteria, the HRPTT identified the primary opportunities for increasing floodplain habitats as setting back levees along Old, Middle, and San Joaquin Rivers.

Channel Margin Habitat Enhancement and Riparian Habitat Restoration

The HRPTT coordinated with NMFS to identify opportunities for enhancing channel margin habitats to benefit rearing and outmigrating juvenile salmonids. The HRPTT generally identified leveed channels along major juvenile salmonid migration pathways through the Delta as the best opportunities for doing so. Because of the landscape position of where riparian habitats occur, opportunities for restoration of riparian habitats where identified as being coincidental with the restoration of tidal marsh (within transitional elevational zones from marsh plain to uplands), enhancement of channel margin habitats (e.g., as a component of constructed low benches along levees), and restoration of seasonally inundated floodplains.

Establishing Habitat Enhancement and Restoration Priorities

Following identification of habitat enhancement and restoration opportunities, the HRPTT developed and applied the following criteria. Results of this prioritization process were used by the Steering Committee to help identify draft BDCP habitat enhancement and restoration targets.

1. Implementation/cost criteria

    - Requires construction of new or relocation of existing major infrastructure (roads, powerlines, levees, railroads, pipelines)
    - Likely extent of significant local concern
    - Level of likely difficulty to secure third party agreements (if necessary) to implement the restoration (e.g., require change in agencies policies/regulations; require legislative or congressional action; require funding contributions by a third party to make cost effective)

- Effects on local Reclamation District infrastructure and functions, including drainage, conveyance, and flood protection and effects on adjacent land uses
- Impacts on the ability to divert water
- Compatibility/integration with east around-Delta conveyance footprint
- Number and size of parcels/landowners
- High maintenance costs relative to other opportunities
- Susceptibility of restored and existing important terrestrial habitat loss to levee failures
- Extent of adjacent lands suitable for sea level rise accommodation
- Existing land uses of high economic value
- Existing conditions/land uses of high ecological value
- Proximity to significant wastewater discharge and diversion points
- Possibility for exacerbating effects of other stressors on covered species

2. Opportunities criteria

- Proximity to important occupied species habitats (e.g., spawning areas, major outmigration corridors)
- Landscape position relative to existing patches of habitat and other habitat restoration sites
- Likely importance in future with sea level rise
- Estimated importance in alleviating species stressors relative to opportunities
- Estimated likelihood for complementary benefits upstream/downstream relative to other opportunities (e.g., good pathways for distributing organic carbon from restored marsh to large portions of the Delta)
- Degree of support by local interests
- Synergies with other planning efforts
- Enhances ability to export and water quality
- Proportion of public land that reasonably could be made available for restoration
- Proximity and availability of suitable fill material where needed for marsh restoration

3. Likely relative magnitude of covered species benefits:

- Sturgeon

- Splittail
- Sacramento River salmonids
- San Joaquin River salmonids
- Delta smelt
- Longfin smelt

Application of these criteria resulted in the identification of the most practicable opportunities for restoring and enhancing habitat for achieving the biological goals and objectives.

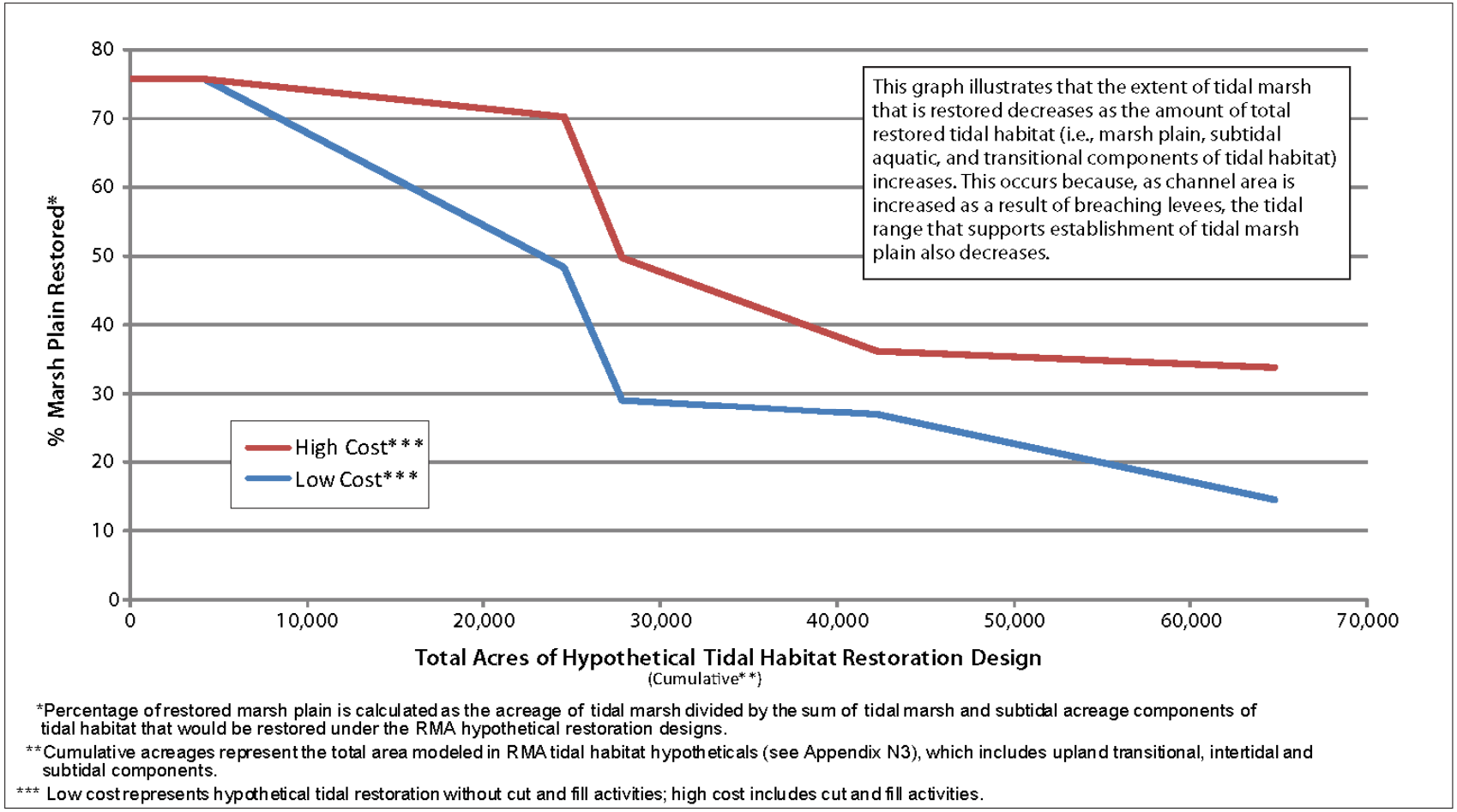
D.6.2.3.2 Establishing Habitat Enhancement and Restoration Targets

The following describes the rationale for the extent of habitat to be enhanced and restored under the BDCP.

Tidal Habitat Restoration Target

In addition to the information developed by the HRPTT regarding tidal habitat restoration opportunities (see Table D-10), the Steering Committee reviewed tidal habitat restoration targets previously proposed by the CALFED Ecosystem Restoration Program, the Ecosystem Restoration Program Stage II Plan, and Delta Vision to help formulate the BDCP tidal habitat restoration target. The Steering Committee established a tidal habitat restoration target of 65,000 acres because 1) it can be reasonably achieved based on the extent of lands that were rated with moderate or higher suitability for tidal habitat restoration (see Table D-10and 2) it restores a substantial proportion of tidal habitat historically present in Delta (approximately 19 percent). Locations suitable for tidal habitat restoration are primarily cultivated or are grasslands. Restoring a larger proportion of the Delta as tidal habitat was deemed to be likely impracticable because it could affect ongoing agricultural uses of the Delta and lead to substantial declines in the extent of remnant grassland habitats. Furthermore, RMA hydrodynamic modeling results (Appendix N3) indicate that dampening of the tidal range that occurs as levees are breached to restore tidal exchange causes the proportion of the restored habitat area that is tidal marsh plain to diminish as the extent of restored tidal habitat increases. This relationship is illustrated in Figure D-18 and indicates that increasing the extent of restored habitat beyond 65,000 acres will not substantially increase the extent of restored tidal marsh plain.

1



2

Figure D-18. Relationship Between Extent of Tidal Marsh Restored and Land Area Restored as Tidal Habitat

Seasonally Inundated Floodplain Restoration Target

The HRPTT identified the primary opportunities for increasing floodplain habitats as setting back levees along Old, Middle, and San Joaquin Rivers. Restoration of 10,000 acres of seasonally inundated floodplain could be accommodated in this area by setting back levees by up to approximately 1,500 feet on each side of these river channels. The extent of setback could be reduced or increased by either increasing or decreasing the length of levees that are set back. Increasing the extent of restored floodplain, however, was not deemed practicable because sufficient flood flows to inundate a larger area would likely only occur at very low frequencies, thus resulting in a minimal increase in benefits for covered fish species.

Channel Margin Habitat Enhancement Target

The BDCP target to enhance 20 miles of channel margin habitat was established to enhance rearing and migration habitat for juvenile salmonids and to mitigate effects of the construction of intakes along the Sacramento River. The habitat will be restored along important channels supporting outmigrating juvenile salmonids. There is uncertainty, however, about the effectiveness of improving channel margin habitat conditions to increase the survival of juvenile salmonids passing through the Delta. Enhancement of 20 miles of channel margin habitat was deemed to be of sufficient extent to determine the effectiveness of enhancing channel margin habitats to increase survival. If channel margin habitats are effective, the BDCP provides for enhancing up to 40 miles of channel margin habitat through the BDCP adaptive management process.

Riparian Habitat Restoration Target

The BDCP target to restore 5,000 acres of riparian habitat will be implemented in conjunction with restoration/enhancement of tidal, seasonally inundated floodplain, and channel margin habitats, where riparian vegetation is expected establish on restored habitat surfaces in locations supporting suitable soils and hydrology. The 5,000 acre target was established to achieve habitat objectives for the riparian-associated covered wildlife species. As described for these species in Chapter 3, *Conservation Strategy*, and Chapter 5, *Effects Analysis*, restoration of 5,000 acres of riparian habitat is expected to be sufficient to mitigate effects and contribute to the recovery of these species.

Table D- 10. Summary of Potential Opportunities for Tidal Marsh Restoration by ROA based on Implementability, Suitability, and Cost

Restoration Opportunity Area and Land Units	*Potential Opportunities for Tidal Marsh Restoration (acres)*					
	Very High	**High**	**Moderate**	**Low**	**Very Low**	**Total Potential**
Yolo Bypass/Cache Slough Complex ROA	10,710	3,760	9,430	1,440	0	25,340
Cosumnes/Mokelumne ROA	0	1,400	2,400	3,510	180	7,490
East Delta ROA	0	0	0	4,740	800	5,540
South Delta ROA	0	0	0	15,300	13,600	28,900
West Delta ROA	1,230	490	880	970	210	3,780
Suisun Marsh ROA	0	37,200	16,400	50	0	53,650
Total	11,940	42,850	29,110	26,010	14,790	124,700

D.6.2.4 Development of Physical Habitat Conservation Measures for Terrestrial Resources

The Steering Committee established the Terrestrial Resources Subgroup under the HRPTT to develop habitat protection, enhancement, and restoration conservation measures to address conservation of the non-tidal natural communities and the covered wildlife and plant species habitats supported by those communities. Restoration of covered wildlife and plant species habitats associated with tidal and riparian habitats were addressed through the development of the aquatic habitat conservation measures. These conservation measures were refined by the Subgroup to incorporate elements that would ensure that these actions would restore habitat for the covered wildlife and plant species that use tidal marsh, tidal mudflat, and riparian habitats,

The primary conservation emphasis for covered wildlife and plant species associated with non-tidal habitats was on the protection and enhancement of existing habitats, thus ensuring that these habitats will not be converted to other habitat types in the future. In addition to the habitat protection and enhancement measures, the Subgroup identified an objective of restoring 2,600 acres of grassland, vernal pool complex, and non-tidal marsh habitats. These restoration actions were developed to contribute to the conservation of the benefiting covered species and to mitigate effects of BDCP implementation.

The following describes the process used to develop the nontidal physical habitat conservation measures.

1. The Subgroup divided the Plan Area into 11 Conservation Zones, each of which represented a discrete geographic area, as a planning tool to provide a basis for spatially distributing the extent of each natural community and covered species habitat to be protected, enhanced, and restored throughout the Plan Area (Figure 3-1).

2. The Subgroup then established habitat conservation targets (i.e., the extent and location of natural communities and habitat types to be protected, enhanced, and restored under the BDCP) that provided the basis for developing the nontidal habitat conservation measures. Information used to establish the targets included:

    - Distribution and extent of each natural community within the Plan Area;
    - Estimated effects of proposed BDCP actions on covered wildlife and plant species and their habitats;
    - Distribution and extent of each covered species' modeled habitat that is located within the Plan;
    - The estimated effects of proposed BDCP actions on natural communities and covered wildlife and plant species and their habitats;
    - Primary threats and stressors for each of the covered species;
    - Location of habitat areas known to be occupied by each of the covered species;
    - The distribution and extent of existing protected patches of each natural community and covered species habitat; and
    - Potential for increasing connectivity with conserved habitat areas adjacent to the Plan Area.

To ensure that the conservation targets would achieve the biological goals and objectives for the covered wildlife and plant species, this information was evaluated for each of the following variables.

- The patch size and connectivity of each natural community with other protected and unprotected natural community patches and connectivity with existing protected natural communities.
- The extent of modeled habitat for covered species that is supported by each natural community within each of the Conservation Zones.
- The habitat value of patches of natural communities for associated covered species and ability to maintain habitats into the future.
- The patch size and connectivity of each covered species modeled habitat to other patches of modeled protected and unprotected species habitat within the Plan Area and habitat adjacent to the Plan Area.

- Location of important known covered wildlife species population centers and covered plant species occurrences.

- Proximity of modeled covered species habitats to known occupied habitats.

- The extent of habitat needed to be conserved to mitigate impacts of the covered activities.

3. The Subgroup then developed conservation land assembly principles that were used to spatially distribute habitat protection and restoration targets to ensure that objectives related to the establishment of ecological corridors, patch size, and other functional attributes of habitat were provided for.

Based on the information developed in items 2 and 3 above, conservation measures were prepared describing the conservation actions that would be implemented to achieve the habitat conservation targets.

D.6.3 Other Stressors Conservation Measures

This section described the history of development of the other stressors conservation measures. "Other stressors" are defined under the BDCP as those environmental stressors to the covered fish species that are not caused by water operations or habitat limitation.

The Other Stressors Working Group began developing other stressors conservation measures in March of 2008. The first task of the working group was to identify the full set of other stressors for the covered fish species. The working group used multiple sources to develop this list, including primary literature, agency reports including biological assessments and opinions, Pelagic Organism Decline (POD) progress reports, DRERIP conceptual models, previous BDCP technical documents, conference proceedings, and personal communication with Delta fish experts. After the full set of others stressors was identified, a list of potential experts was assembled for each other stressor. These experts included federal, state, and local government agency staff; university professors; professional researchers; NGO staff; PRE staff; and private consultants.

BDCP consultants then began researching each other stressor identified. Consultants conducted literature reviews and interviewed experts on each stressor. Multiple informational presentations were given at meetings during which a set of solution opportunities was identified for each stressor. Subject experts were also asked to present research and additional information on specific stressors.

On July 22, 2008, after the initial phase of Other Stressors Working Group meetings to identify other stressors, determine their potential effects on the covered species, and identify solution opportunities, the working group identified an initial set of 43 draft conservation measures, many of which were evaluated during the DRERIP coarse-level evaluations during Summer 2008.

Based in part on DRERIP coarse-level evaluations, the Other Stressors Working Group modified the list of other stressors conservation measures. Some draft measures were combined and others were removed. A set of 35 draft other stressors conservation measures was delivered to the BDCP Steering Committee in September of 2008.

The Other Stressors Working Group then developed a process for prioritizing the 35 draft conservation measures based on four primary factors:

1. The conservation measure avoids, minimizes, and/or mitigates take (i.e., take related to BDCP actions) or contributes to recovery of covered species.

2. The conservation measure enhances or restores habitat (including critical habitat) for covered species.

3. There could be reliable, efficient, and accountable implementation of the conservation measure over 50 years.

4. The underlying action is not already required by law or under the jurisdiction of another agency.

This process resulted in the removal of 13 conservation measures. The remaining 22 conservation measures were then subject to three important questions regarding conservation credit:

1. Will the conservation measure happen because BDCP took an action?

2. Will the conservation measure provide a meaningful benefit to covered fish species?

3. Will BDCP receive "credit" from Fishery Agencies for implementing the conservation measure? ("credit" could be either formal regulatory credit or other less formal credit from Fishery Agencies for providing benefits to species).

From this exercise, 16 conservation measures were submitted for analysis during the DRERIP full evaluation in winter 2009. During summer 2009, based on results of the DRERIP analysis and other new scientific and regulatory information, the Other Stressors Working Group met to update the list of other stressors conservation measures. Existing measures were reorganized as either conservation measures or conditional actions, or were combined into other conservation measures, such as combining the conservation measure to create no-wake zones in restored habitat areas to the habitat restoration conservation measures. In addition, previously discarded conservation measures were reviewed for potential revival and new conservation measures were proposed.

The summer 2009 exercise produced 19 other stressors conservation measures that were evaluated as part of the BDCP Mini-Effects Analysis in late 2009 and early 2010. The set of 19 other stressors conservation measures was presented to the Steering Committee on January 29,

2010. At this meeting, based on the results of the Mini-Effects Analysis and new scientific information, the Steering Committee agreed to one of five actions on each other stressors conservation measure:

1. Keep as a conservation measure;
2. Delete from the BDCP;
3. Delete, but analyze as an important related action (IRA)[7];
4. Move to the BDCP research program; and
5. Keep but revise and combine into habitat restoration conservation measures.

The other stressors conservation measures were evaluated during the mini-effects analysis and the full analysis during 2010 to determine their expected beneficial or adverse effects on covered fish species. *[Note to reviewers: This will be updated as the analyses are completed.]*

Important related actions were separately evaluated during the same period. After evaluation of these actions, it was decided that all IRAs should be added back into the BDCP as conditional measures.

Throughout the conservation measure development process, new scientific findings were incorporated, as well as additional discussions with experts and other third parties experienced with managing the other stressors identified. This information was used to further refine the descriptions of conservation measures as well to modify the full list of conservation measures.

D.7 Conservation Measures Evaluated in the Effects Analysis

This section describes the process of the effects analysis for the BDCP. The purpose of the effects analysis was to evaluate the effects of the BDCP covered activities and conservation measures on covered species and natural communities and inform the conservation strategy.

Development of the approach to the effects analysis began in June 2009 when the BDCP consultants proposed to NMFS, USFWS, USBR, DWR and DFG a combined effects analysis that would be used in preparation of the following documents:

1. BDCP HCP/NCCP,
2. BDCP EIR/EIS biological resources section,
3. BDCP biological assessment (BA), and
4. USFWS and NMFS biological opinions (BOs).

[7] Important related actions (IRAs) are defined as those conservation measures thought to be beneficial to covered fish species that are the responsibility of other federal, state, or local government agencies.

The process was refined between the consultants and agencies over the following few months until the mini-effects analysis began in November 2009. The BDCP Steering Committee identified long-term proposed operations in July 2009 and near-term proposed operations in September 2009. As discussed above, these proposed operations were evaluated during the mini-effects analysis along with the set of proposed habitat restoration and other stressors conservation measures identified in July 2009.

The mini-effects analysis was conducted between November 2009 and January 2010. The analysis was separated into three groups: foodweb and water quality, anadromous fish, and pelagic fish. Groups were composed of experts from agencies, NGOs, PREs, and consultants that were selected by Effects Analysis Managers. The analysis primarily consisted of weekly, all-day meetings of these groups to discuss and document the effects of proposed actions on the covered fish species, and group members conducted analyses and wrote results. The results were documented as a set of tables for each species that were organized by lifestage and stressor. The purpose of the mini-effects analysis was to identify any major red flags in the conservation strategy and elevate these red flags to the Steering Committee.

Based on conclusions from the mini-effects analysis, the Steering Committee made revisions to the proposed Conservation Strategy at the January 29, 2010 and February 11, 2010 Steering Committee meetings. Immediately following the February 11, 2010 meeting, physical modeling of the revised set of operational criteria commenced. The full effects analysis also includes the analysis of the BDCP on covered plant and wildlife species and natural communities. These operational criteria and the list of the conservation measures in Table D-11 were approved by the Steering Committee to be evaluated in the Effects Analysis.

[Note to reviewers: This will be updated upon completion of the effects analysis.]

Table D- 11. BDCP Conservation Measures as of March 25, 2010

[*To come*]

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